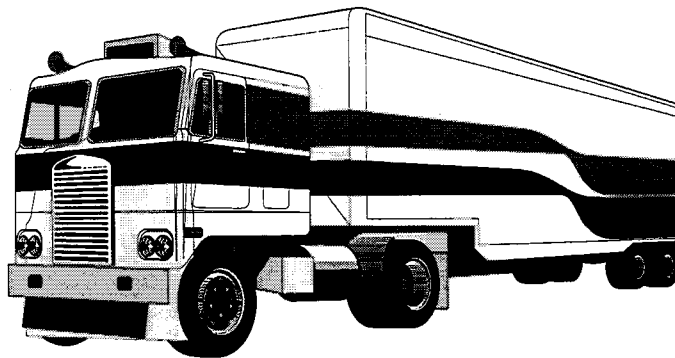




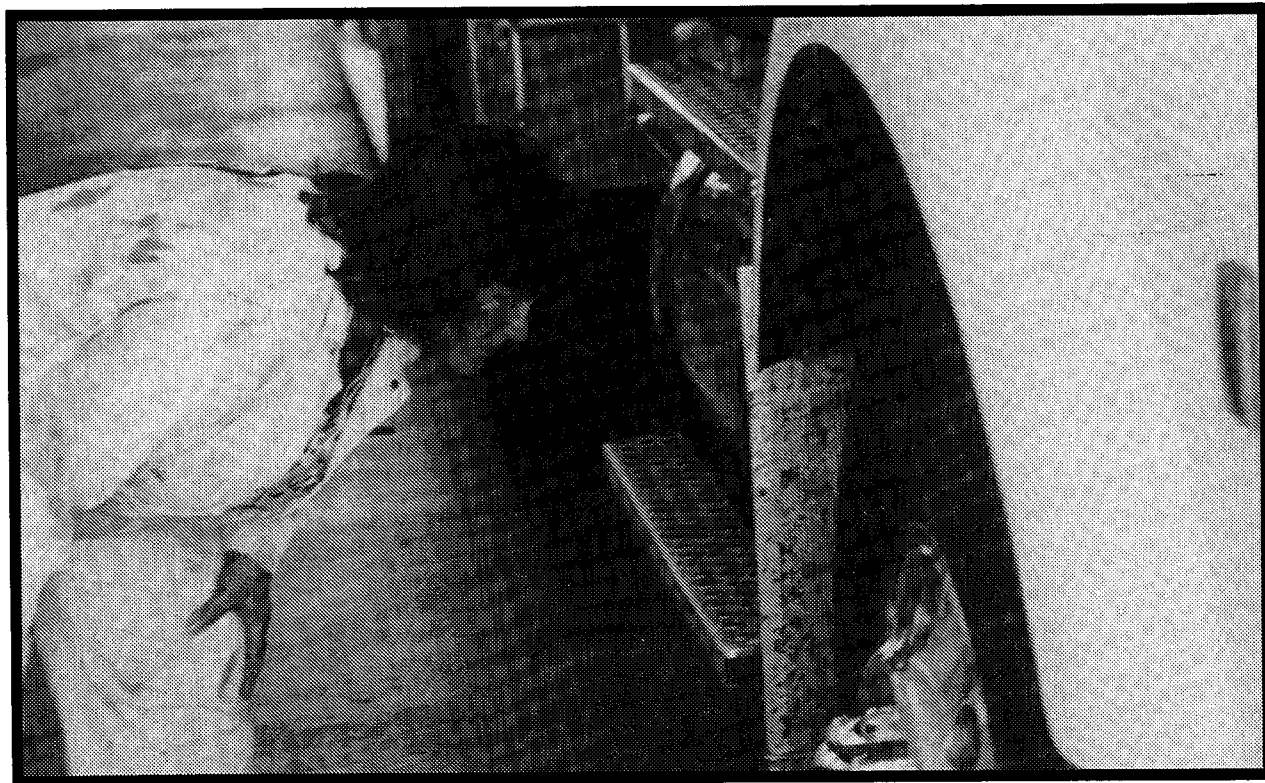
U.S. Department
of Transportation

**Federal Highway
Administration**



Inspections of Interstate Commercial Vehicles 1994

Office of Motor Carriers



Publication No. FHWA/MC-96-0012

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Inspections of Interstate Commercial Vehicles 1994

Publication No. FHWA/MC-96-0012

Prepared by:

**The Scientex Corporation
1655 N. Fort Myer Drive
Arlington, VA 22209**

Prepared for:

**Office of Motor Carriers
Federal Highway Administration
U.S. Department of Transportation
Washington, D.C. 20590**

March 1996

HIGHLIGHTS OF THE 1994 REPORT

1994 OVERVIEW

- 1.4 million driver-vehicle safety inspections were conducted on *interstate* commercial motor carriers in Calendar Year 1994. (Inspections on vehicles operated by *intrastate* carriers are not reflected in these statistics.)
- 3.5 million violations—and 0.7 million out-of-service violations—were detected during the year.
- Three in 4 inspections contained violations of the *Federal Motor Carrier Safety Regulations*, *Hazardous Materials Regulations*, or comparable State codes.
- Three in 10 inspections ended with the vehicle or driver being placed out-of-service.
- On average, 250 violations—and 50 out-of-service violations—were detected per 100 inspections.
- Seven in 10 violations involved safety defects in the vehicle.
- Defects in brakes, lighting, and tires accounted for 45 percent of all violations.
- Ninety-eight percent of all inspections were performed using one of three methodologies: Level I (Full Inspections)—46 percent; Level II (Walk-Around Inspec-

tions)—35 percent; Level III (Driver-Only Inspections)—17 percent.

- For the five-year period, 1990-94, interstate inspection activity increased 32 percent, while the number of violations detected increased 12 percent.
- From 1990-94, the mean number of violations detected per 100 inspections decreased from 293 to 250; out-of-service violation rates went from 75 to 50.

CARRIER AND VEHICLE ATTRIBUTES

- Nine in 10 inspections in 1994 were attributable to carriers identified by the Office of Motor Carriers.
- Of the 129,000 known carriers who were inspected, 86 percent were inspected 10 times or less during the year; one percent had over 100 inspections apiece.
- Known carriers were inspected, on average, 9 times each during the year.
- Three-fourths of inspections where carrier type was discernible involved for-hire carriers.
- One-half of inspections where fleet size was known involved carriers operating 38 power units or less.

- Smaller carriers had consistently higher violation rates than did larger carriers. For example, carriers operating fewer than 12 vehicles experienced, on average, 288 violations per 100 inspections; carriers with over 5,000 vehicles had, on average, 155 violations.
- Eight in 10 inspections involved tractor-trailers, mostly singles.
- As the number of units comprising an inspected vehicle increased, *vehicle* violation rates went up slightly: straight trucks—152 violations per 100 inspections, singles—182, doubles—196. (The pattern did not hold for triples which had a vehicle violation rate of 178.) As the number of units increased, however, driver violation rates declined significantly: straight trucks—73, singles—71, doubles—57, triples—36.
- Buses were represented in 1.4 percent of all inspections, but experienced just 0.7 percent of all violations. Buses had the lowest violation rate of any vehicle group—whereas the violation rate for all vehicle types was 250 per 100 inspections, the rate for buses was 127.
- One in 10 inspected vehicles was transporting hazardous materials at the time of the inspection; on average, 55 hazardous materials violations were detected per 100 hazardous materials inspections. The overall vehicle-and-driver violation rate for inspections where hazardous materials were present was lower (192 violations per 100 inspections) than the rate for inspections where hazardous materials were not present (257).

THE INSPECTION ENVIRONMENT

- All 50 States, plus the District of Columbia, participated in the 1994 national inspection program.
- Inspections were variously conducted at *fixed* and *mobile* facilities.
- Inspections at fixed facilities tended to result in higher *vehicle* violation rates, while inspections at mobile facilities had higher *driver* and *hazardous materials* violation rates.
- More inspections were performed in warmer weather than colder weather—for instance, 24 percent more inspections occurred in Spring than Winter. Non-Winter inspections tended to result in higher violation rates.
- Eighty percent of all inspections were conducted between 6AM and 6PM, with the heaviest concentration of activities occurring before noon.
- Daytime inspections produced 17 percent higher violation rates than did nighttime inspections.
- The average inspection was 31 minutes in length.
- Longer inspections resulted in the citation of more violations.
- Level I (Full Inspections), of all the inspection methodologies, produced the highest violation rates per hour of inspection activity.

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INTRODUCTION

This document presents aggregate statistics derived from the *1994 Interstate Motor Carrier Inspection Database*. The database was compiled from the records of driver-vehicle inspections conducted during Calendar Year 1994 by State and Federal officials responsible for commercial motor vehicle safety. The database is maintained by the Office of Motor Carriers (OMC), Federal Highway Administration, U.S. Department of Transportation.

This publication is intended to be used by individuals and organizations desiring general information on the safety fitness of interstate commercial carriers, as measured by driver-vehicle inspections conducted under the auspices of the *Motor Carrier Safety Assistance Program* (49 U.S.C. 350 and 355). Readers seeking general information will usually find that the materials in this document satisfy their basic data needs. Persons requiring more specialized information should contact the OMC directly.

Scope of the Report

In 1994, State and Federal officials conducted 1,976,973 inspections of commercial vehicles engaged in interstate or intrastate commerce. This report, however, covers only those inspections of vehicles of carriers engaged in *interstate* commerce. "Interstate carriers" are defined to include (1) carriers who sometimes or always operate in inter-

state or foreign commerce, and (2) carriers of hazardous materials who operate in interstate, intrastate, or foreign commerce. A total of 1,385,131 inspections—or 70 percent of all inspections performed during the year—were determined to involve interstate carriers.

This report is limited to those data elements collected during driver-vehicle inspections and furnished to the OMC. Many States collected additional information, beyond what was mandated by the OMC, and used the data to satisfy specialized State requirements; these specialized data elements were never furnished to the OMC. Thus, this document reports only those essential data elements commonly collected by all participants in the national inspection program.

This report provides a general overview of 1994 inspection activity, including aggregate summaries of inspection outcomes, identification of major defects identified during the inspection process, and the examination of key variables which appear to influence inspection outcomes. The report *does not* contain information about specific trucking firms, and it *does not* include information, such as the identification of individual drivers, protected by data privacy rules.

Nearly all 1994 inspections were conducted by State personnel. However, 2,475 inspections — or 0.18 percent of total interstate

inspections completed during the year—were performed by Federal staff. This document reports the results of interstate inspections conducted both by State and Federal officials.

Driver-Vehicle Inspections of Interstate Carriers

The Federally-funded *Motor Carrier Safety Assistance Program* (MCSAP) provides grants to States, the District of Columbia, and U.S. Territories for the conduct of commercial vehicle safety enforcement activities. In 1994, all States and Territories participated in MCSAP during all or part of the year except for Northern Marianas and the Virgin Islands. The principal agency responsible for commercial vehicle safety varied from State to State, but typically included one of the following: the State Police or Highway Patrol, State Department of Transportation, or State Public Utilities Commission.

Driver-vehicle inspections are the primary enforcement activities performed under MCSAP. Inspections are conducted in accordance with standards developed by the Commercial Vehicle Safety Alliance (CVSA) in cooperation with the OMC. These standards establish national uniform inspection procedures and criteria for identifying violations of the *Federal Motor Carrier Safety Regulations* (49 CFR 382, 383, 387, and 390-399) and the *Hazardous Materials Regulations* (49 CFR 170-177). The standards include specification of out-of-service (OOS) violations, which preclude operation of a commercial vehicle by its driver (1) for a prescribed period of time, or (2) until specific vehicle defects are corrected or other conditions met.

Five different types of inspections are con-

ducted under MCSAP. The five types are:

- **Level I: North American Standard (NAS) Inspection.** The most comprehensive and thorough of the inspection types, it also normally takes the longest to administer. This inspection technique involves extensive vehicle checks—including under-the-vehicle measurement of brake performance—and examination of hours-of-service logs. In this report, Level I inspections are referred to as *Full Inspections*.
- **Level II: Walk-Around Driver-Vehicle Inspection.** Follows most procedures of the NAS inspection, except those actions which can only be accomplished by climbing underneath the vehicle (e.g., to measure brake performance). In this report, Level II inspections are referred to as *Walk-Around Inspections*.
- **Level III: Driver-Only Inspection.** Examines only the driver-related aspects of the NAS inspection, including compliance with commercial drivers' licensing (CDL) requirements, medical certifications and waivers, and the hours-of-service regulations. In this report, Level III inspections are referred to as *Driver-Only Inspections*.
- **Level IV: Special Inspection.** Ad hoc examination of particular items, usually inspected in support of a particular study or verification/refutation of a specific trend. Unlike Inspection Levels I-III, this level does not normally connote a distinctive inspection methodology per se—in practice, the methodology employed tends to vary from one special study to the next. Consequently, few analytic conclusions can be made about the data at this level since the inspection technique is not

consistent across the category. In this report, Level IV inspections are referred to as *Special Studies*.

- **Level V: Terminal Inspection.** Examination of vehicles at carriers' terminal facilities. Although the inspection methodology employed may vary, a walk-around vehicle inspection (similar to the Level II technique without the "driver" component) is generally used. Terminal Inspections normally focus only on the "vehicle" aspects of the inspection process. In this report, Level V inspections are referred to as *Terminal Inspections*.

Most inspections are conducted at permanent State Commercial Vehicle Weigh-In Facilities. But inspections are also performed at other locations, including mobile inspection sites, carrier terminals, and parking lots.

Data-Processing

In 1994, most inspection results were recorded on hardcopy State inspection reports. The reports were then forwarded to central State locations where they were entered into the SAFETYNET database. SAFETYNET is a State-based information system supporting the collection, processing, and analysis of commercial carrier safety data. Edit checks in SAFETYNET were used to ensure the general accuracy and consistency of inputs. Following completion of all edit procedures, and preliminary determination of carriers' State and USDOT Numbers, all inspection records pertaining to interstate carriers were uploaded to the OMC mainframe computer in Washington, D.C. (The USDOT Number is a unique carrier identifier used to keep track of inspection and other safety records associated with a given carrier.)

On the mainframe, additional edit checks were performed, final determinations of USDOT Numbers were completed, and the inspection records were loaded into the 1994 *Interstate Motor Carrier Inspection Database*.

To compile this annual report, USDOT Numbers in the Inspection Database were used to establish links to the *Motor Carrier Census Database*, which contains general descriptive information (fleet size, annual miles travelled, etc.) for each of the commercial carriers regulated by the OMC. These links, of course, could not be created for inspection records to which USDOT Numbers were not appended, and thus not all records in the 1994 inspection database could be associated with specific carriers. However, where counts of inspections and inspection outcomes were not specific to any carrier, all records were included—regardless of whether the records contained USDOT Numbers.

General Approach

This report provides *snapshots* of 1994 inspection activity. It chronicles key patterns and trends in the 1994 data and, when appropriate, engages in rudimentary data analysis. The report is written for a broad audience, including readers not necessarily schooled in the technical subject matter. Consequently, the report vociferously avoids the use of most formal statistical terms and techniques.

Data in the report are presented as succinctly as possible. When only raw numbers or percentages are shown, effort is made to provide enough information so that readers with specialized needs can calculate some of the data not provided.

Major concepts employed in this report include the following:

- Raw *counts* of inspection activity are displayed at every turn. This is the report's primary "quantitative" measure.
- Inspection *outcomes* are calculated and compared in the form of *violation rates*, i.e., the number of violations detected per 100 vehicle inspections. Distinctions are drawn between *general violation rates*, which are calculated for all violations identified, and *OOS violation rates*, which are calculated on those violations resulting in vehicles or drivers being placed out-of-service. "Violation rates" is one of the report's primary "qualitative" measures.
- An index, called the *violation-to-OOS violation ratio*, is used to assess the *severity* of violations. The ratio gauges the proportion of violations which resulted in the issuance of out-of-service citations. Lower ratios usually mean that more severe violations were identified. The "violation-to-OOS violation ratio" is another of the report's "qualitative" measures.
- Violations are broken down into specific defect categories: *vehicles*, *drivers*, and *hazardous materials*. In this report, defects pertaining to the physical truck are always credited to the "vehicle"; defects pertaining to the operator are always credited to the "driver"; and defects involving hazardous materials are always attributed to the "hazardous materials" category.
- Five specific defects are used throughout the report to illustrate violation patterns generally. The five defects are: *brakes*, *lighting*, *hours-of-service*, *placarding*, and *shipping paper*. Two of the defects

pertain to the vehicle, one is a driver defect, and two are hazardous materials defects. The five specific defects were selected because they represent the most prevalent violations within each of the defect categories.

These concepts are examined in greater detail in the body of the report.

Organization of the Document

This report moves from a *general* discussion of inspection activities and outcomes, to a more detailed assessment of the *internal* (carrier and vehicle) factors which influence inspection outcomes, and concludes with an examination of the *external* (environmental) factors which affect these outcomes.

The topics are explored in three chapters, as follows:

- **Chapter 1: 1994 Overview**
- **Chapter 2: The Impact of Carrier and Vehicle Attributes**
- **Chapter 3: The Impact of the Inspection Environment**

Within each chapter, data are organized under specific topics. A glossary of terms and a depiction of common vehicle configurations are presented in the Appendix.

Data Conventions

The following conventions are used through this document:

- Percentages shown in tables and figures are rounded to the nearest one-tenth or one-hundredth of one percent, as appropriate. Percentages do not always total

"100" due to rounding.

- Items in inspection records which were left blank, or which were too varied to group into meaningful categories, are noted in tables and figures under categories labelled "Other", "Unidentified", etc.
- When the size of the sample from which data in a given figure were drawn is not readily apparent, the sample size is identified at the base of the figure. For example, "N=1,385,131" means that the data shown were drawn from 1,385,131 inspection records.

Additional Information

For responses to questions not addressed in this publication, please contact the Federal Highway Administration, Office of Motor Carriers, HIA-10, 400 Seventh Street, S.W., Washington, D.C. 20590. The telephone number is 202-366-4023.

CHAPTER 1

1994 OVERVIEW

Inspection Totals Violation Counts Summary of Defects Five-Year Trends

Nearly 1.4 million driver-vehicle inspections were conducted on interstate motor carriers in Calendar Year 1994. Three in four inspections contained violations, and three in ten inspections involved one or more out-of-service violations. Collectively, the inspections resulted in the detection of 3.47 million violations, and nearly 700,000 out-of-service violations; this equates to an average rate of 250 violations—and 50 out-of-service violations—per 100 inspections. Seven in ten violations detected during inspections involved vehicle defects—indeed, brake, lighting, and tire violations together accounted for 46 percent of all violations. From 1990-94, interstate carrier inspection activity increased 32 percent. Over the five-year period, the mean number of violations detected per 100 inspections decreased from 293 to 250; out-of-service violation rates decreased from 75 to 50.

INSPECTION TOTALS

The 1,385,131 inspections of interstate vehicles and drivers conducted in 1994 may be divided into four classes:

- *Inspections/No Violations.* Includes inspections in which violations were not identified.
- *Inspections/Violations.* Includes inspections which resulted in the detection of one or more violations.
- *Inspections/No OOS Violations.* Includes

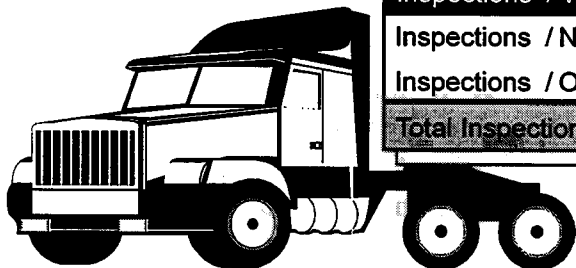
inspections where violations designated as "out-of-service" were not identified.

- *Inspections/OOS Violations.* Includes inspections where one or more violations were designated as "out-of-service."

Table 1-1 summarizes the 1994 data using these inspection classes. Figure 1-1 depicts, pictorially, the relationships among the classes. Three of every four inspections contained at least one violation, and more than one of every four inspections contained one or more out-of-service violations. Almost two out of every five inspections with violations resulted in the driver or vehicle being placed out-of-service.

Figure 1-2 compares 1994 inspections, proportionally, by inspection level. The majority of inspection activities— 46 percent—involved *Full Inspections*; 35 percent consisted of *Walk-Around Inspections*, while 17 percent were comprised of *Driver-Only Inspections*. The remaining two percent included *Terminal Inspections* conducted at carriers' places of business and miscellaneous *Special Studies*. Figures 1-3 and 1-4—which were derived from the numeric breakout of data in Table 1-2—offer the first evidence of a significant relationship between inspection level and inspection class. Although the percentage of inspections with violations for Full and Walk-Around Inspections was 79 and 80 percent, respectively, the proportion with

Table 1-1
1994 Inspection Totals



Inspection Classes	Number
Inspections / No Violations	326,311
Inspections / Violations	1,058,820
Inspections / No OOS Violations	987,163
Inspections / OOS Violations	397,968
Total Inspections	1,385,131

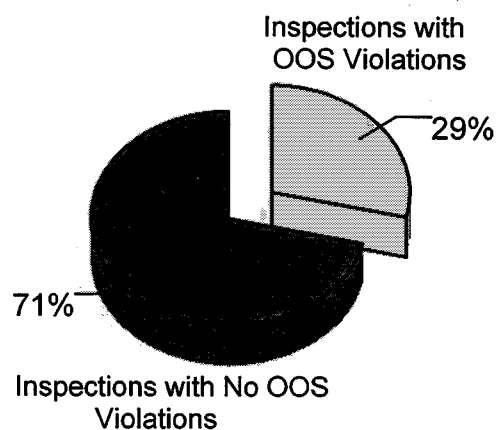
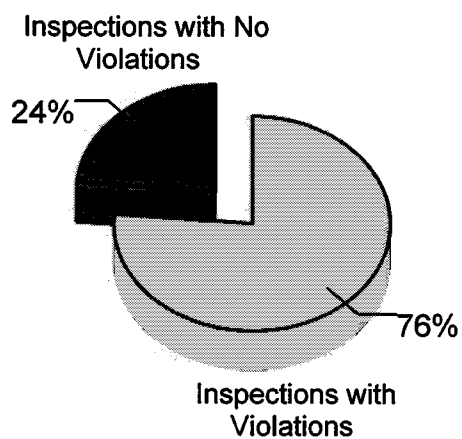


Figure 1-1
1994 Inspection Class Comparison
N=1,385,131

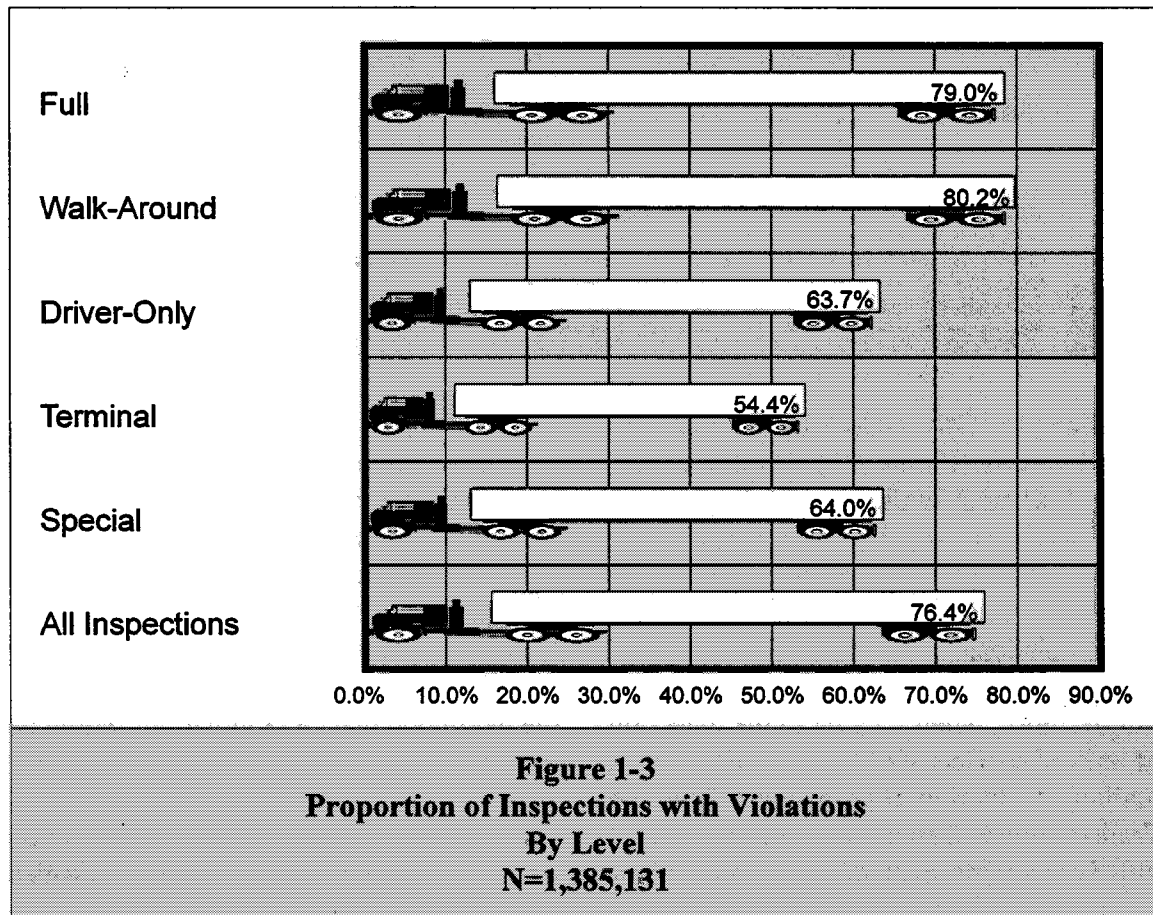
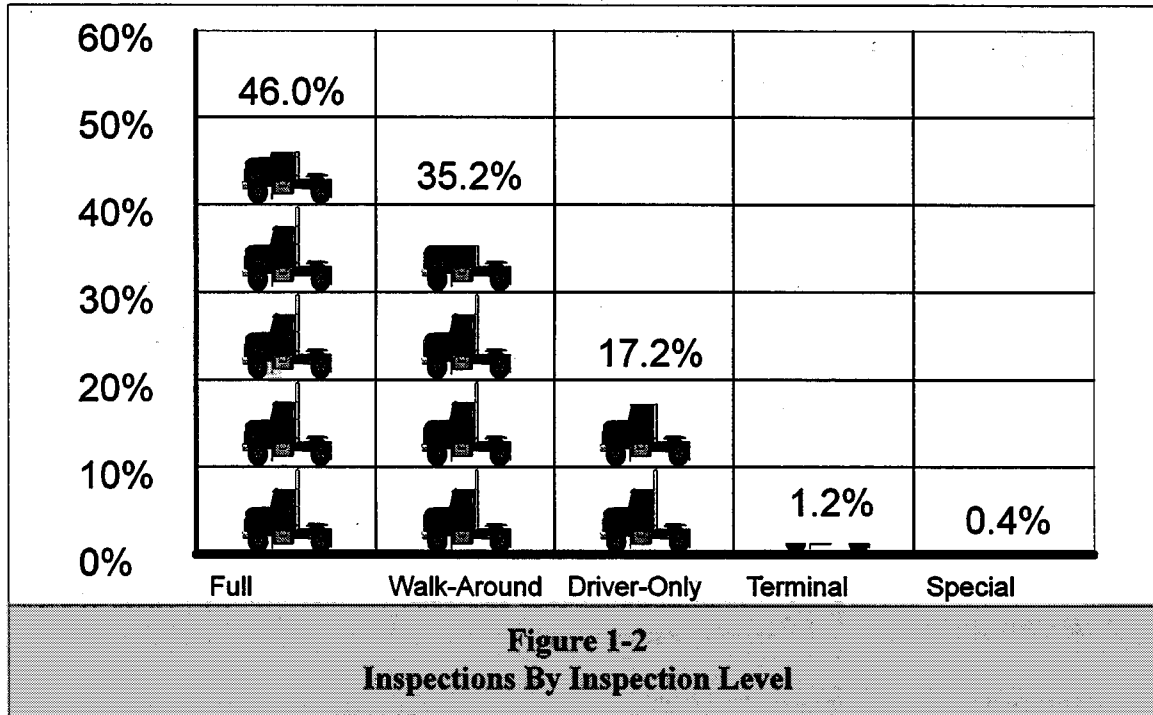


Table 1-2
Inspection Totals by Inspection Class
And Inspection Level

	Full	Walk-Around	Driver-Only	Terminal	Special	All Inspections
Inspections/No Violations	133,646	96,433	86,532	7,778	1,922	326,311
Inspections/Violations	502,895	391,682	151,528	9,293	3,422	1,058,820
Inspections/No OOS Violations	396,363	367,979	205,417	13,435	3,969	987,163
Inspections/OOS Violations	240,178	120,136	32,643	3,636	1,375	397,968
Total Inspections	636,541	488,115	238,060	17,071	5,344	1,385,131

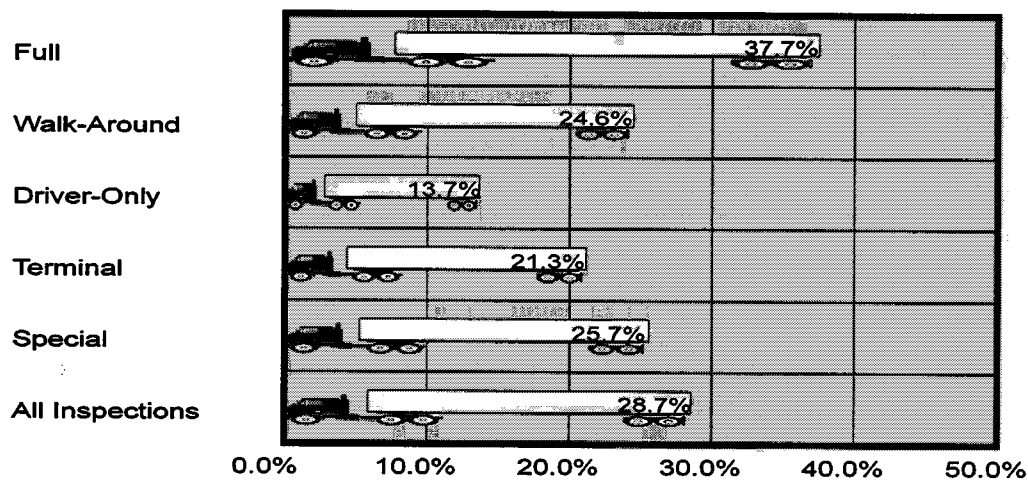


Figure 1-4
Proportion of Inspections with Out-of-Service Violations
By Level
N=1,385,131

violations for Driver-Only Inspections was just 64 percent (Figure 1-3). In other words, while Full and Walk-Around Inspections were nearly equally likely to result in the detection of at least one violation, Driver-Only Inspections tended to result in the detection of fewer violations.

Furthermore, when it came to the detection of out-of-service violations, there was a marked distinction even between Full and Walk-Around Inspections: 38 percent of Full Inspections resulted in the identifica-

tion of one or more OOS violations, as compared to only 25 percent of Walk-Arounds (Figure 1-4); just 14 percent of Driver-Only Inspections detected OOS violations. In general, movement up the continuum of inspection methodologies—from Driver-Only Inspections to Walk-Arounds to Full Inspections—appeared to increase the likelihood that OOS violations would be detected.

This relationship between inspection levels and inspection outcomes is a theme to which

we will return throughout this report.

As shown in Table 1-3, inspections with violations may be further divided into: *inspections with vehicle-only violations*, *inspections with driver-only violations*, and *inspections with both vehicle and driver violations*. Of the nearly 1.1 million inspections with violations—non-OOS and OOS violations—43 percent involved vehicle-only violations, 29 percent contained both vehicle and driver violations, and 28 percent involved driver-only violations. Although sizable percentages of Full and Walk-Around Inspections resulted in vehicle-only violations, Full Inspections produced proportionally more vehicle-only violations than did Walk-Arounds (60 versus 36 percent); Walk-Arounds, on the other hand, spawned proportionally more driver-only violations than did Full Inspections (27 versus 8 percent).

Similar patterns may be discerned among the 398,000 inspections containing OOS violations (Table 1-4): Full Inspections produced proportionally more vehicle-only OOS violations than did Walk-Arounds (55 versus 35 percent); again, Walk-Arounds resulted in more driver-only OOS violations than did Full Inspections (18 versus 4 percent). Walk-Arounds contained a slightly higher proportion of inspections with both vehicle and driver OOS violations than Full Inspections (48 versus 41 percent).

Figure 1-5 compares inspection outcomes by the number of violations identified. Over fifty percent of all 1994 inspections contained one to three violations per inspection; 17 percent contained five or more violations each. Figure 1-6 looks only at those inspections with out-of-service violations: 41 per-

Table 1-3
Proportion of Inspections with Violations
By Violation Group and Inspection Level

	Full	Walk-Around	Driver-Only	Terminal	Special	All Inspections
Vehicle-Only Violations	59.7%	36.0%	0.7%	92.7%	39.1%	42.7%
Driver-Only Violations	7.8%	26.9%	98.6%	1.5%	30.3%	27.9%
Both Vehicle and Driver	32.6%	37.1%	0.7%	5.9%	30.7%	29.4%
Total Inspections with Violations	502,895	391,682	151,528	9,293	3,422	1,058,820

Table 1-4
Proportion of Inspections
With Out-of-Service Violations
By Violation Group and Inspection Level

	Full	Walk-Around	Driver-Only	Terminal	Special	All Inspections
Vehicle-Only OOS Violations	55.1%	34.8%	0.4%	92.4%	40.8%	44.8%
Driver-Only OOS Violations	4.1%	17.7%	98.9%	0.4%	16.5%	16.0%
Both Vehicle and Driver OOS Violations	40.8%	47.5%	0.7%	7.2%	42.7%	39.2%
Total Inspections with OOS Violations	240,178	120,136	32,643	3,636	1,375	397,968

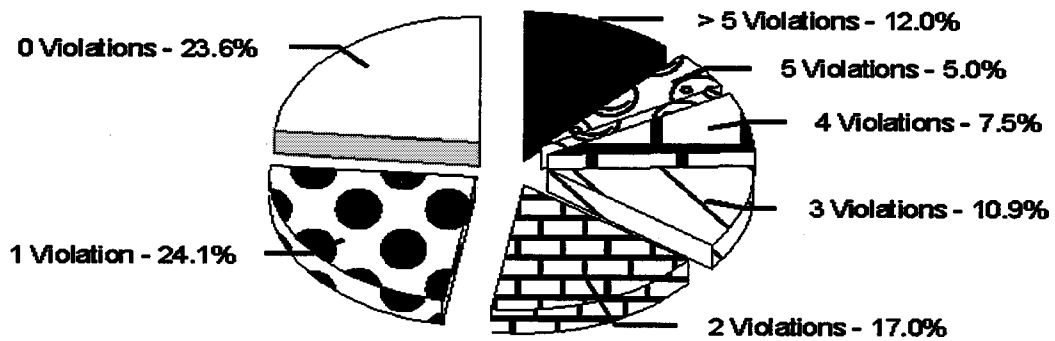


Figure 1-5
Total Inspections by Incidence of Violations
N=1,385,131

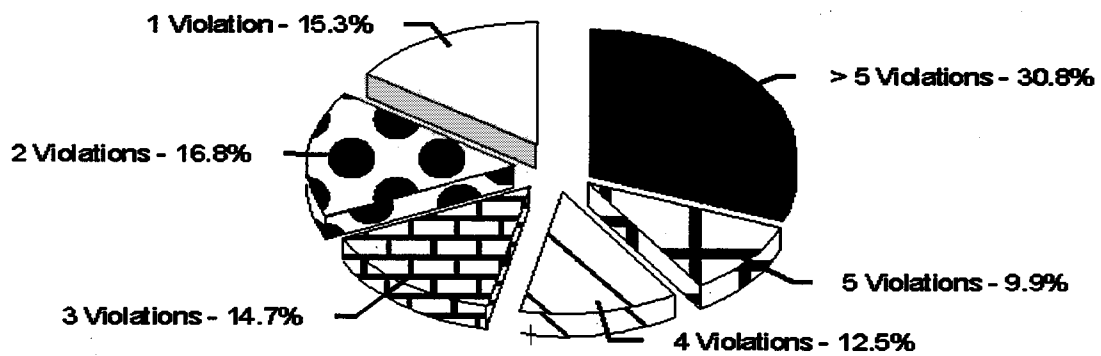


Figure 1-6
Total Inspections with Out-of-Service Violations
By Incidence of Out-of-Service Violations
N=397,968

cent of the OOS inspections contained five or more OOS violations.

VIOLATION COUNTS

The 1.4 million driver-vehicle inspections of interstate carriers in 1994 involved nearly 3.5 million violations, including 0.7 million out-of-service violations (see Table 1-5). The average inspection resulted in 2.5 violations and 0.5 out-of-service violations.

Figure 1-7 compares *violation rates*—meas-

ured as the mean number of violations per 100 inspections—for each inspection level. In general, the data reinforce what was observed in the preceding section: namely, that the more thorough the inspection methodology, the larger will be the volume of violations likely to be detected. For every 100 Full Inspections conducted in 1994, 321 violations (including 72 OOS violations) were, on average, identified. This compares to 238 violations (including 37 OOS violations) for Walk-Arounds and 96 violations (including 16 OOS violations) for Driver-

Table 1-5
Violation and Out-of-Service Violation Counts
By Inspection Level

	Full	Walk-Around	Driver-Only	Terminal	Special	All Inspections
Total Violations	2,040,525	1,160,110	229,223	28,636	9,727	3,468,221
Total OOS Violations	460,938	181,598	37,229	6,373	2,318	688,456
Total Inspections	636,541	488,115	238,060	17,071	5,344	1,385,131

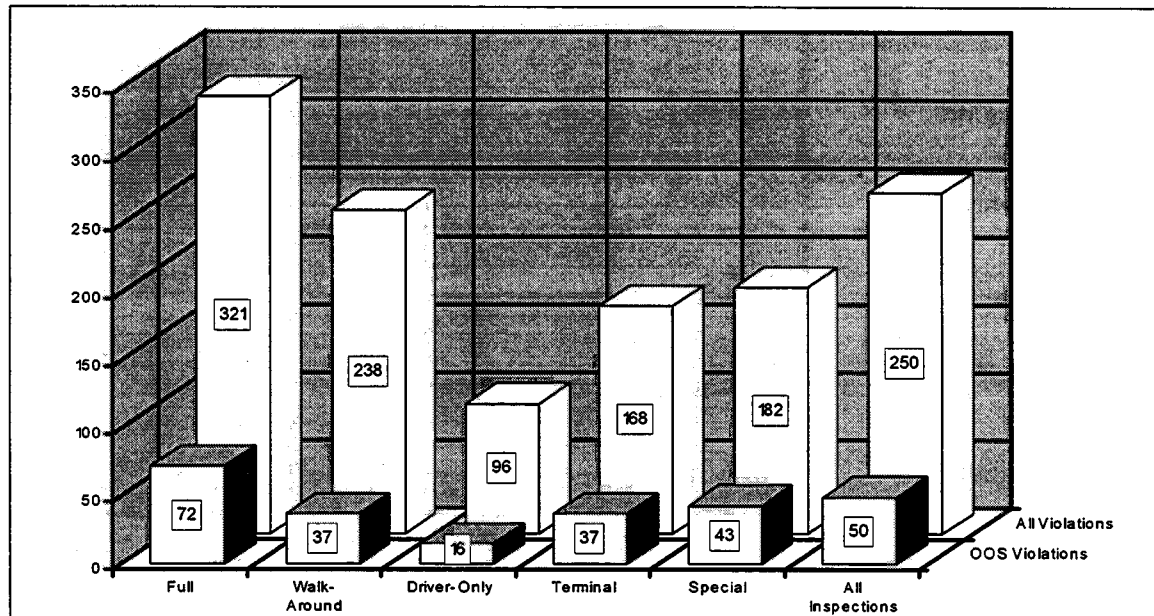


Figure 1-7
Violation Rates per 100 Inspections
By Inspection Level

Only Inspections.

Looking at the data this way offers potentially valuable insights. For example, in the previous section (see Figure 1-3), it was observed that inspections were equally likely to result in the identification of at least one violation, regardless of whether Full Inspections or Walk-Arounds were conducted. Here, however, the data strongly support the argument that Full Inspections, as opposed to Walk-Arounds, are likely to result in the discovery of a larger number of violations per inspection.

This, of course, does not mean that Full Inspections are always, necessarily, the methodology of choice. For one thing, Full Inspections generally require more time to perform than do the other inspection levels.

For another, the comparisons shown in Figure 1-7 are quantitative, not qualitative.

Without even examining the specific violations identified by the various inspection methodologies, one can still begin to make qualitative comparisons. One way to do this is to look at differences in the ratios of *total violations* to total out-of-service violations among the methodologies, on the assumption that those vehicle and driver violations having the highest potential to imperil public safety are designated "out-of-service." A ratio of 1:1 would mean that every violation identified was OOS; a ratio of 10:1 would mean that for every ten violations identified, one was OOS. The utility of this exercise is that it reveals differences in the abilities of the various inspection methodologies to identify critical OOS violations.

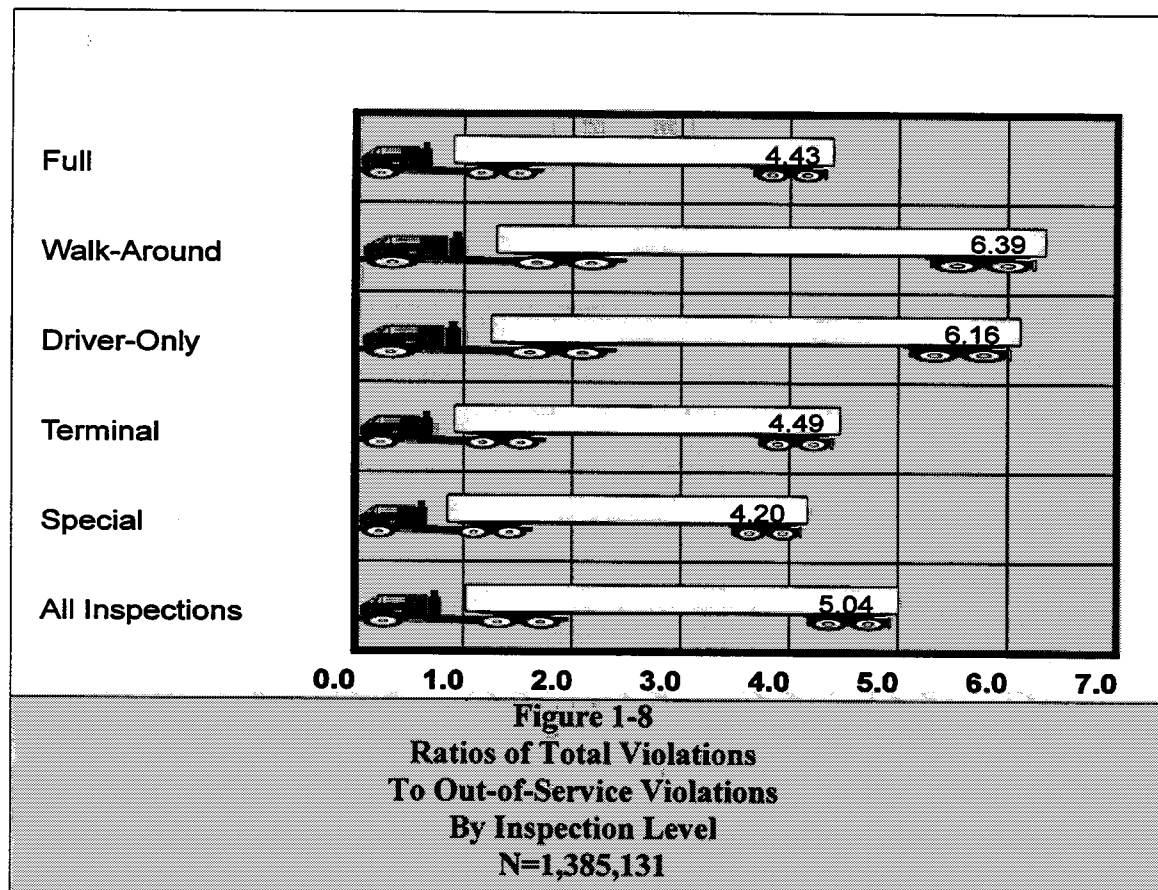


Figure 1-8 graphically depicts the ratios of total violations to OOS violations. The average for all levels of inspections is 5.0:1, which means that for every 5.0 violations cited, one violation resulted in the vehicle or driver being placed out-of-service. In other words, Full Inspections (with a ratio of 4.4:1) were much more likely than Walk-Arounds (6.4:1) and Driver-Only Inspections (6.2:1) to produce OOS violations. Interestingly, Terminal Inspections also exhibited one of the lowest violations/OOS violations ratios at 4.5:1.

SUMMARY OF DEFECTS

Violations identified during the inspection process may be grouped according to whether the defect pertained to the *vehicle*, *driver*, or *hazardous materials*. Figure 1-9, on the following page, depicts the relationships among the three defect groups for 1994; the charts were pre-

Table 1-6 Violation and Out-of-Service Violation Counts By Defect Group		
	All Violations	OOS Violations
Vehicle	2,412,492	516,620
Driver	974,060	155,050
HazMat	70,561	16,501
Unidentified	11,108	285
Total	3,468,221	688,456

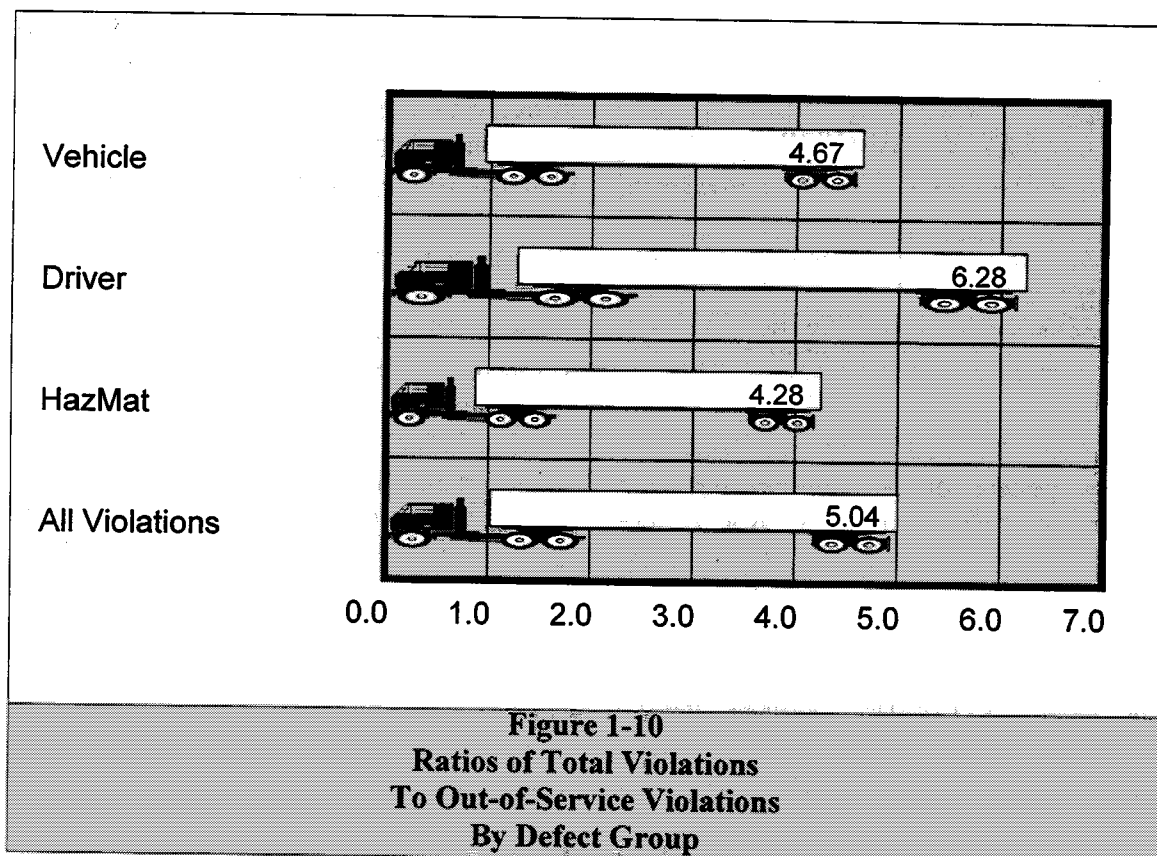
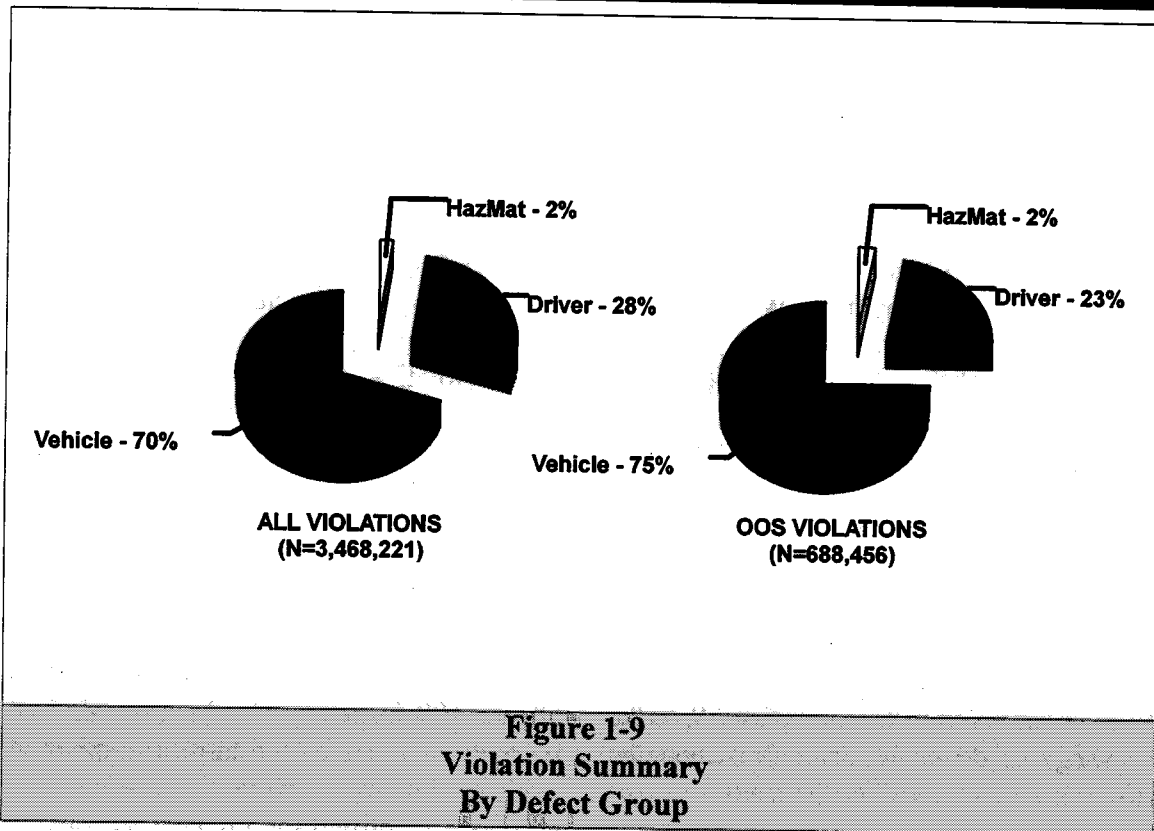
pared using the data shown in Table 1-6. Seventy percent of all violations—and 75 percent of OOS violations—involved defects to the vehicle. Most of the remaining violations pertained to drivers. Figure 1-10 compares the ratio of total violations to OOS violations by defect group: one out of every four hazardous materials violations resulted in an out-of-service citation; this contrasts with one out-of-service violation for every

six driver violations. Indeed, this is consistent with general perceptions that violations involving hazardous materials frequently imperil the public safety and are, therefore, more likely to result in OOS citations.

Figure 1-11 compares violation rates by inspection level for vehicle and driver defects. Averages of 174 vehicle violations and 70 driver violations per 100 inspections were detected across all inspection levels. However, violation rates for individual inspection levels deviated significantly from the averages. For example, when Full Inspections were conducted, the proportion of vehicle violations increased beyond the average (to 263 per 100 inspections), but the proportion of driver violations decreased (to 50 per 100 inspections). In general, Full Inspections detected the largest number of vehicle violations, while Driver-Only Inspections identified the greatest number of driver violations (95 per 100 inspections). Walk-Arounds detected more driver violations than Full Inspections (87 per 100 inspections), and many more vehicle violations than Driver-Only Inspections (142 per 100 inspections).

Similar patterns may be observed when OOS violation rates by inspection level are compared (Figure 1-12). Interestingly, vehicle violations detected during Full Inspections were much more likely to result in OOS citations (1 out of 5.2 violations) than were those observed during Walk-Arounds (1 out of 10.2 violations), perhaps because the majority of brake violations were detected during Full Inspections. This differential across the two inspection levels, though still present, was much less pronounced when driver violation rates were compared.

Examination of violation rates for hazardous materials was limited, of course, only to



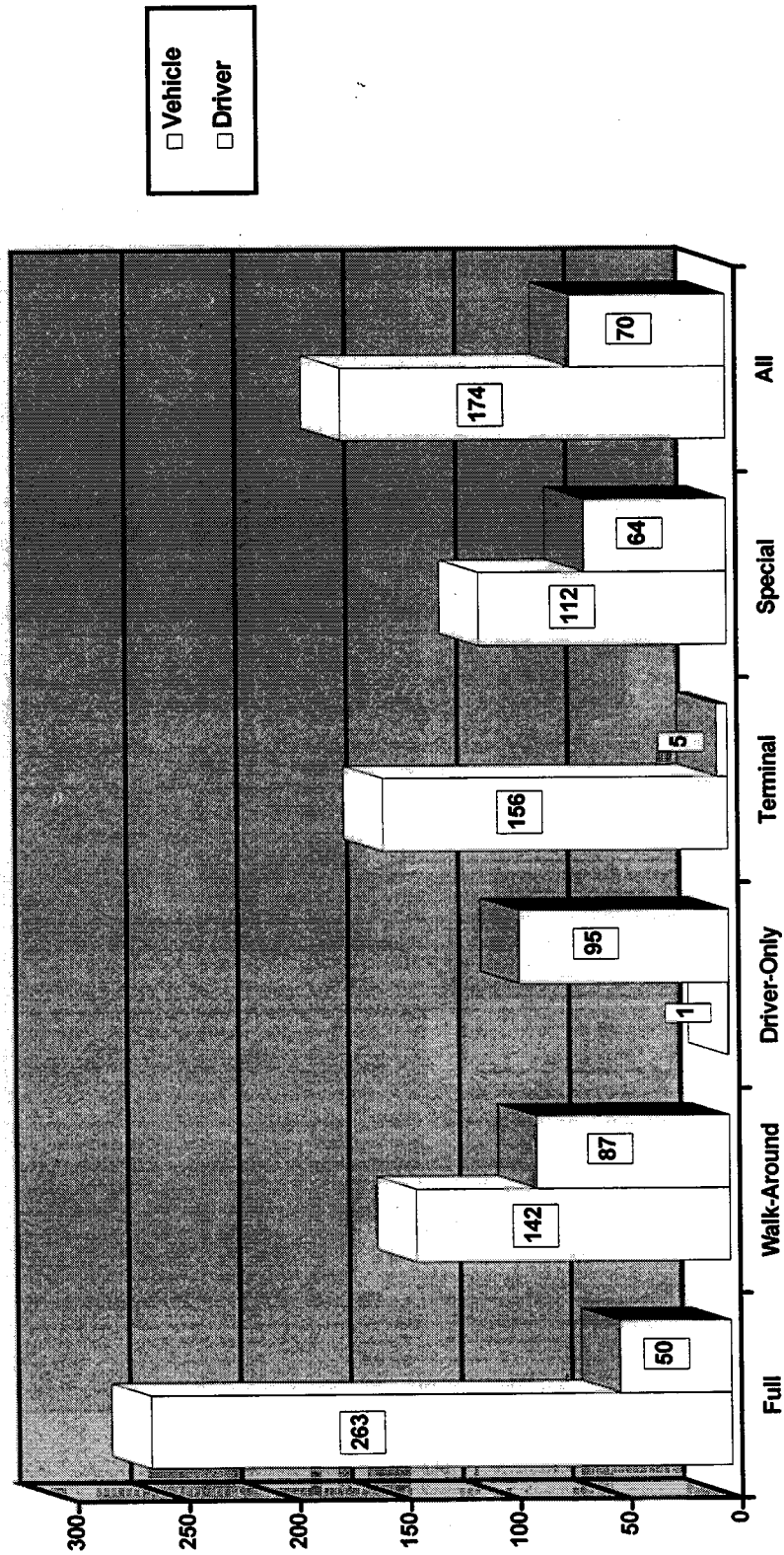
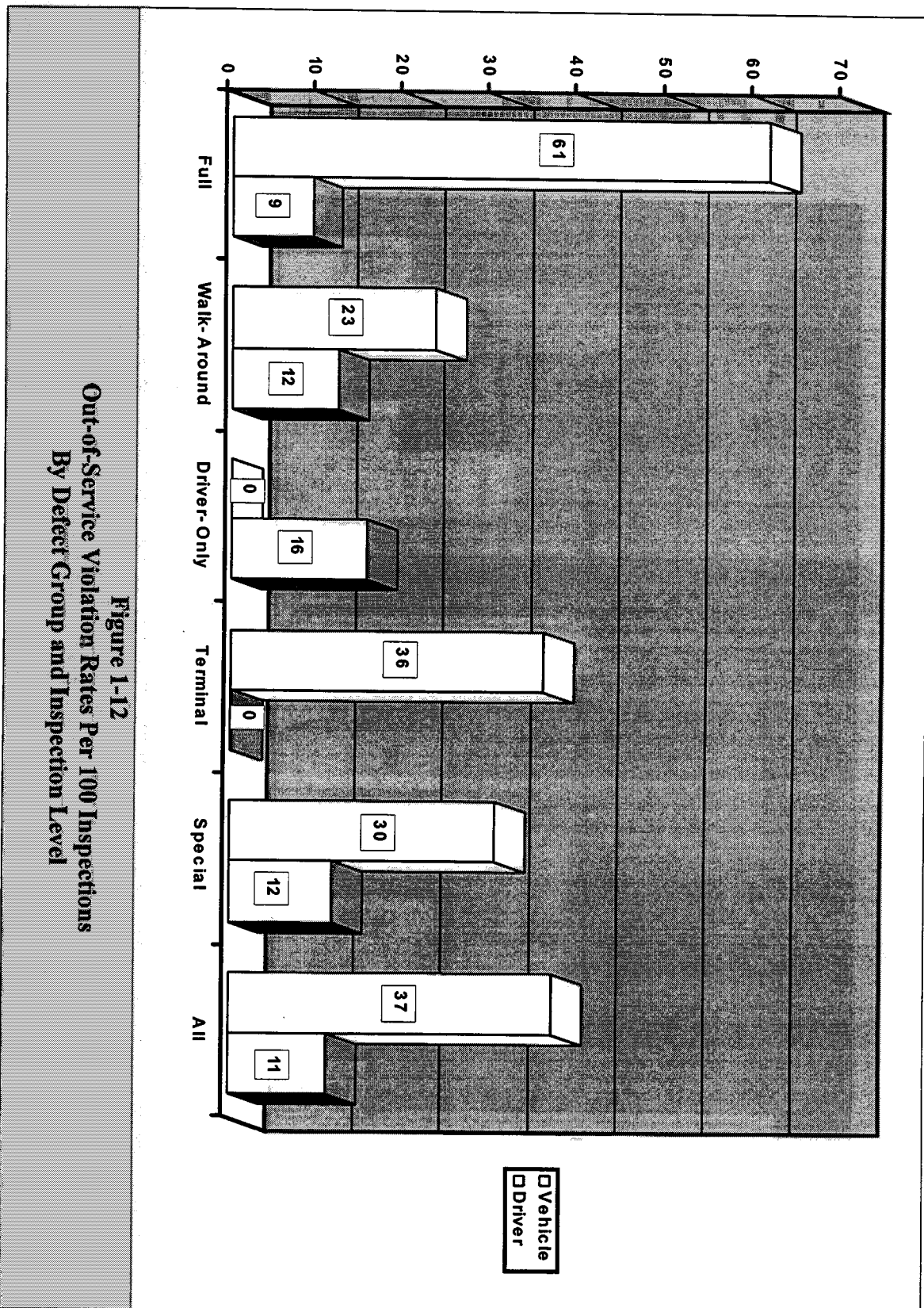


Figure 1-11
Violation Rates Per 100 Inspections
By Defect Group and Violation Category



those inspections where the vehicles were transporting hazardous materials at the time of the inspection. Figure 1-13 shows that 10 percent of all inspections involved hazardous materials.

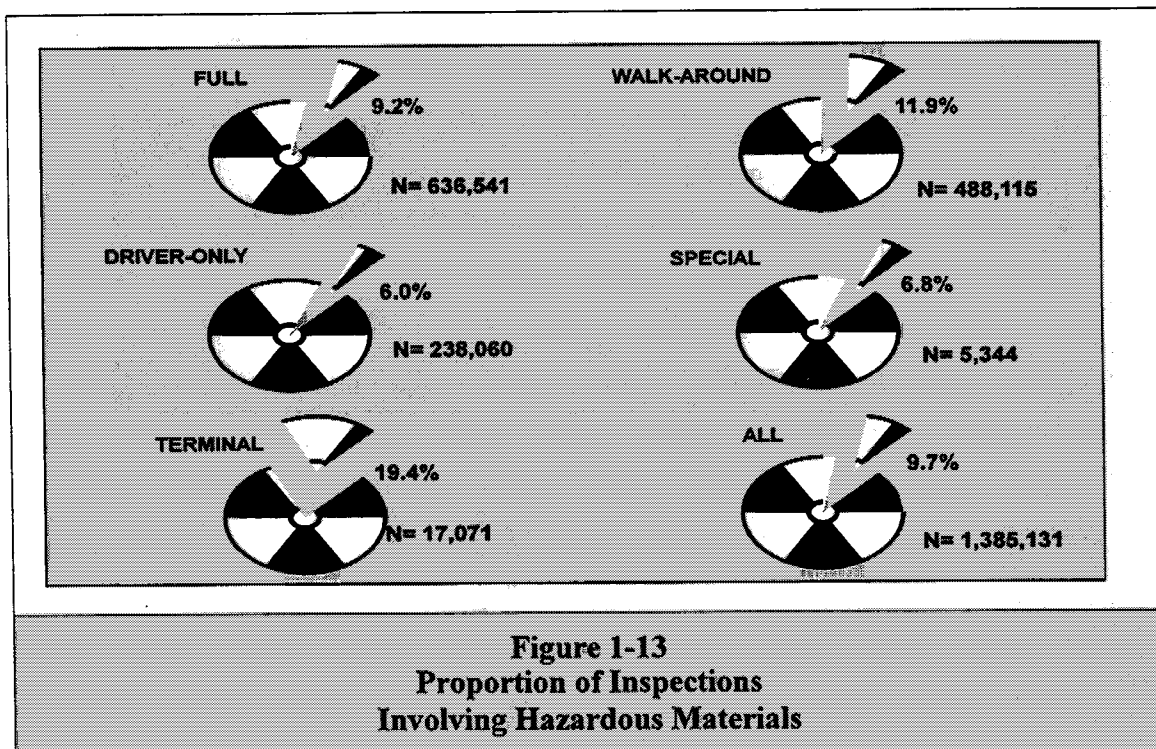
Figure 1-14 compares hazardous materials violation rates by inspection level. In general, the violation rate for hazardous materials was lower than the rate for vehicle and driver violations: there were 55 hazardous materials violations per 100 "hazmat" inspections versus 174 and 70, respectively, for vehicle and driver violations. That pattern, however, did not hold up when hazardous materials OOS violations were compared to driver OOS violations—there were 12 hazardous materials OOS violations per 100 "hazmat" inspections versus only 11 driver OOS violations.

Finally, according to the 1994 data, Walk-Arounds were more likely to detect hazard-

ous materials violations (68 violations per 100 "hazmat" inspections) than were Full Inspections (55 violations per 100 inspections); both types of inspections detected an average of 14 hazardous materials OOS violations per 100 hazmat inspections.

Table 1-7 shows counts for specific violations which occur under the three defect groups: vehicle, driver, and hazardous materials. ("Other" refers to violations containing insufficient information to be attributable to any of the defect groups.) Figures 1-15 through 1-17 compare violation and OOS violation rates within each of the defect groups. Again, the hazardous materials violation rates (Figure 1-17) were calculated only for those inspections involving hazardous materials.

Figure 1-18 compares violation rates, by inspection level, for selected defects: (1) brakes, (2) lighting, (3) hours-of-service, (4) placarding, and (5) shipping paper. Brakes



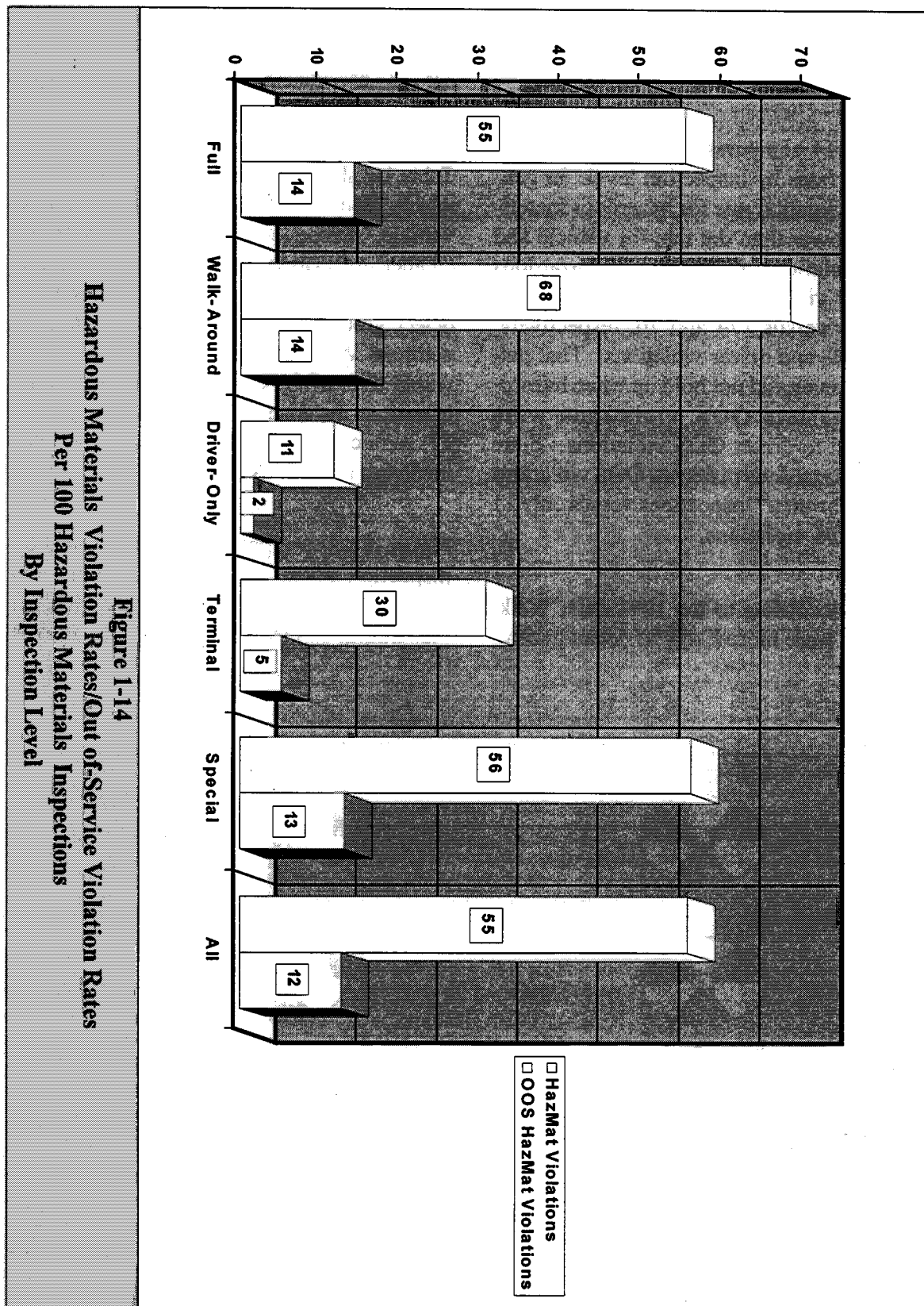
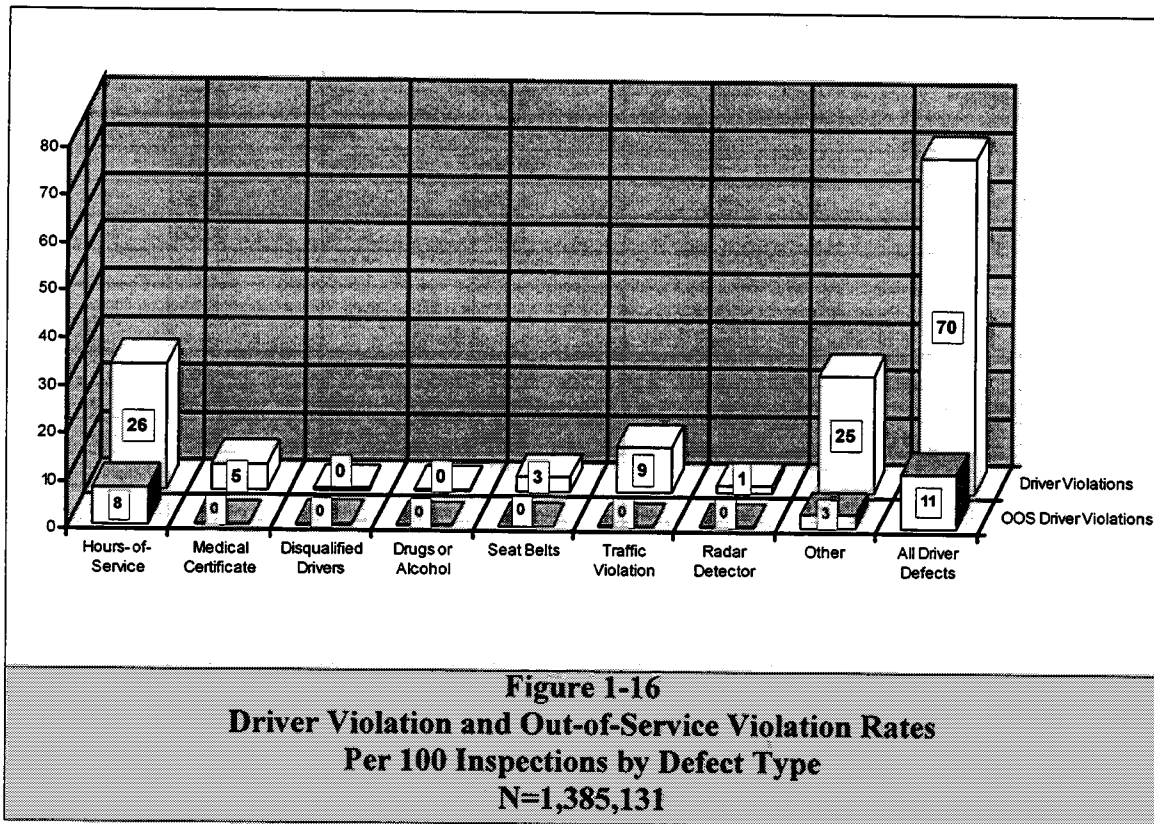
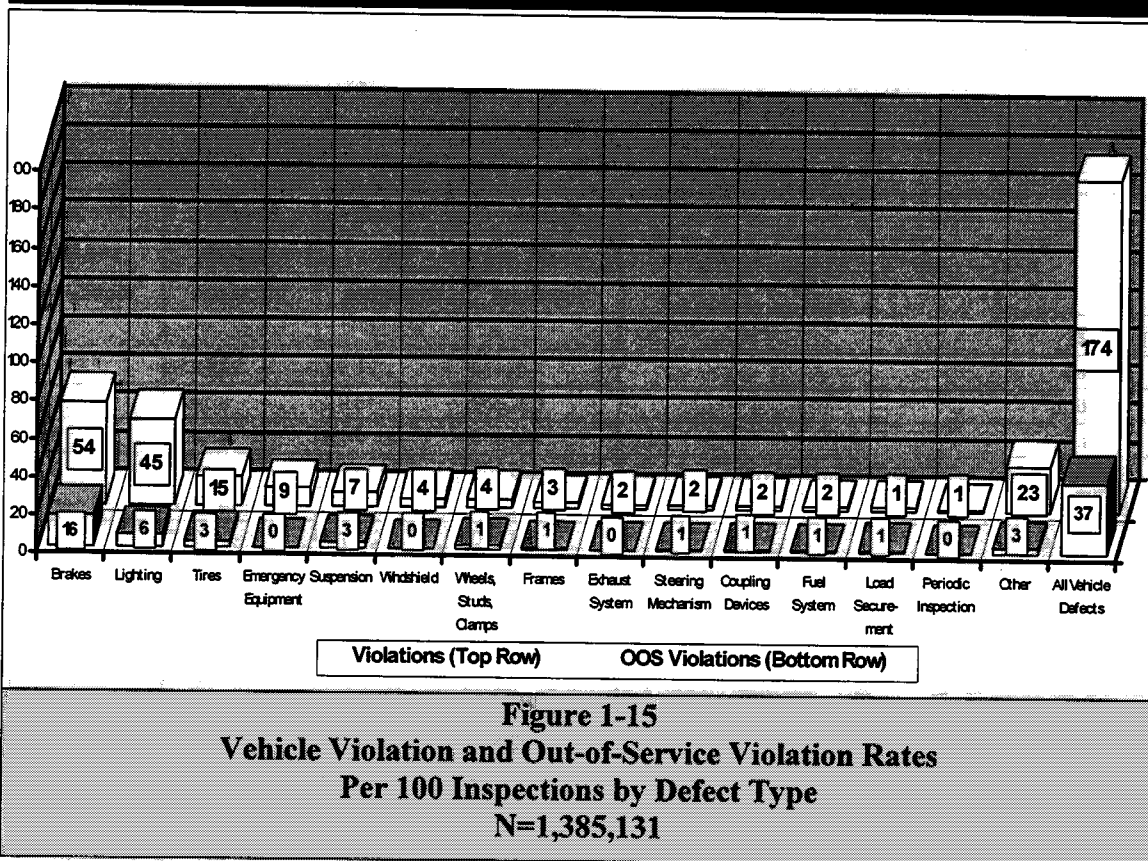


Table 1-7
Violation and Out-of-Service Violation Counts
By Specific Defect

	Number of Violations	Percent of Violations	Number of OOS Violations	Percent of OOS Violations
VEHICLE				
Brakes	745,189	21.5%	227,230	33.0%
Lighting	624,889	18.0%	82,521	12.0%
Tires	206,445	6.0%	47,638	6.9%
Emergency Equipment & Warning Device	126,206	3.6%	1,643	0.2%
Suspension	94,025	2.7%	41,126	6.0%
Windshield	58,990	1.7%	728	0.1%
Wheels, Studs, and Clamps	57,532	1.7%	20,196	2.9%
Frame	39,618	1.1%	9,098	1.3%
Exhaust System	31,124	0.9%	4,078	0.6%
Steering Mechanism	29,242	0.8%	8,641	1.3%
Coupling Device	25,656	0.7%	9,344	1.4%
Fuel System	22,537	0.6%	9,664	1.4%
Load Securement	20,749	0.6%	13,063	1.9%
Periodic Inspection	7,061	0.2%	15	0.0%
Other Vehicle Defects	323,229	9.3%	41,635	6.0%
DRIVER				
Hours of Service	363,583	10.5%	105,416	15.3%
Traffic Violation	127,354	3.7%	1,411	0.2%
Medical Certificate	73,754	2.1%	1,826	0.3%
Seat Belts	41,288	1.2%	202	0.0%
Radar Detector	19,596	0.6%	544	0.1%
Disqualified Driver	5,615	0.2%	4,731	0.7%
Drugs or Alcohol	3,447	0.1%	3,006	0.4%
Other Driver Defects	339,423	9.8%	37,914	5.5%
HAZMAT				
Placarding	21,536	0.6%	5,462	0.8%
Shipping Paper	21,096	0.6%	5,023	0.7%
Blocking and Bracing of Cargo	3,086	0.1%	2,344	0.3%
Cargo Tank Retest and Inspection	2,672	0.1%	144	0.0%
Emergency-Response Procedure	2,007	0.1%	226	0.0%
Specification Container	1,499	0.0%	537	0.1%
Marking of Shipment	1,383	0.0%	184	0.0%
Remote Shutoff Control	814	0.0%	97	0.0%
Other Hazardous Materials Defects	16,468	0.5%	2,484	0.4%
OTHER	11,108	0.3%	285	0.0%
		0.0%		0.0%
ALL	3,468,221	100.0%	688,456	100.0%



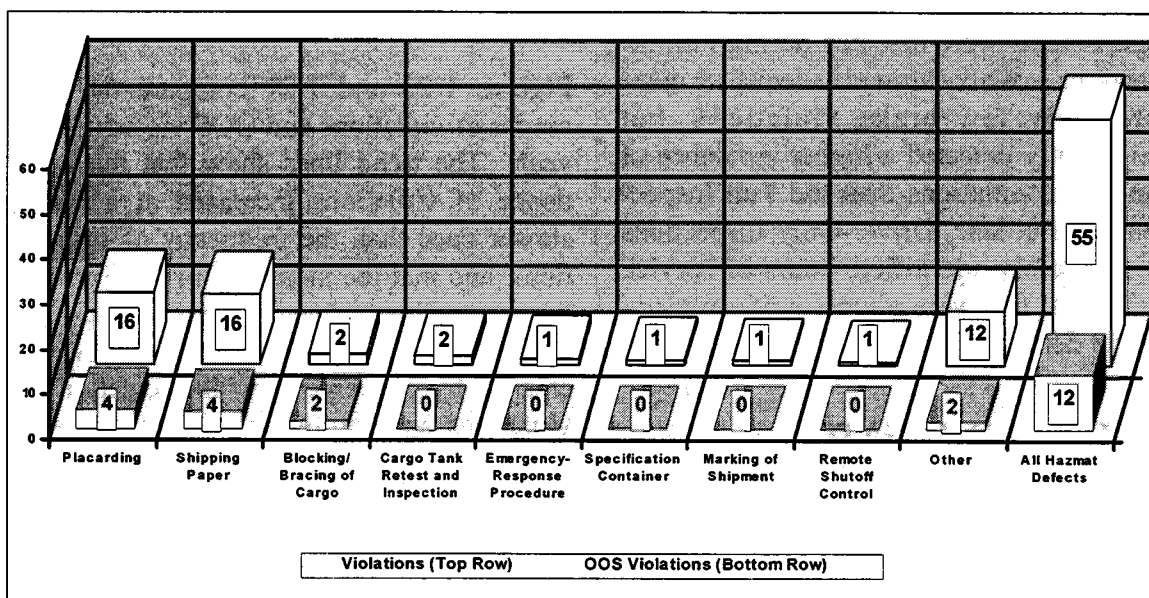


Figure 1-17
Hazardous Materials Violations and Out-of-Service Violation Rates
Per 100 Hazardous Materials Inspections
By Defect Type

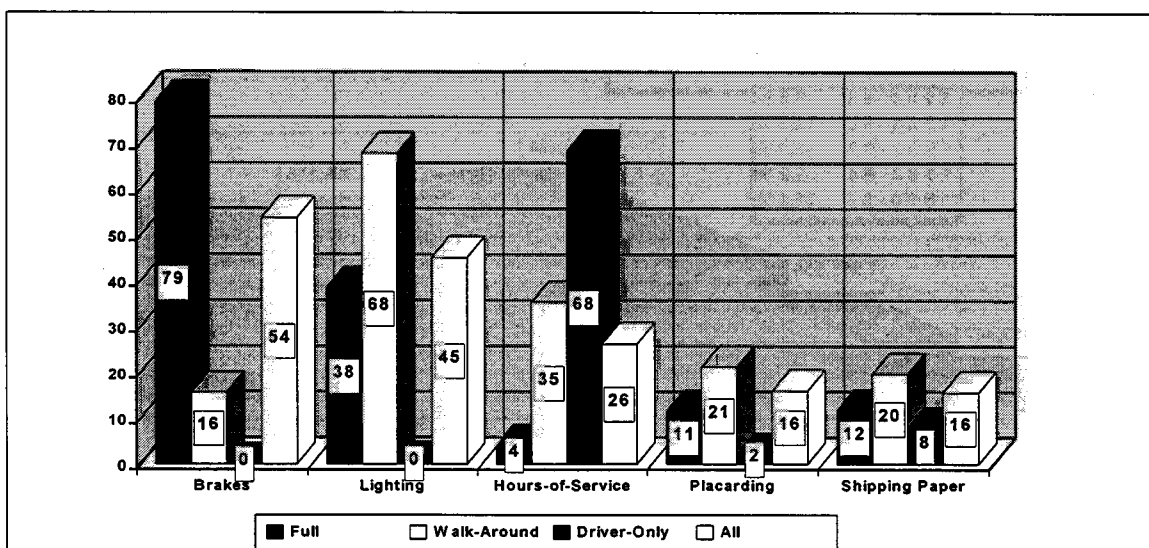


Figure 1-18
Selected Defects by Inspection Level
Violation Rates per 100 Inspections

accounted for 22 percent of all inspection defects identified in 1994, and nearly all of these defects were detected during Full Inspections. Walk-Arounds identified comparatively few brake violations, but consistently detected a higher incidence of non-brake violations than did Full Inspections. Of course, Driver-Only Inspections most adeptly identified hours-of-service violations, but were almost uniformly unable to detect non-driver violations.

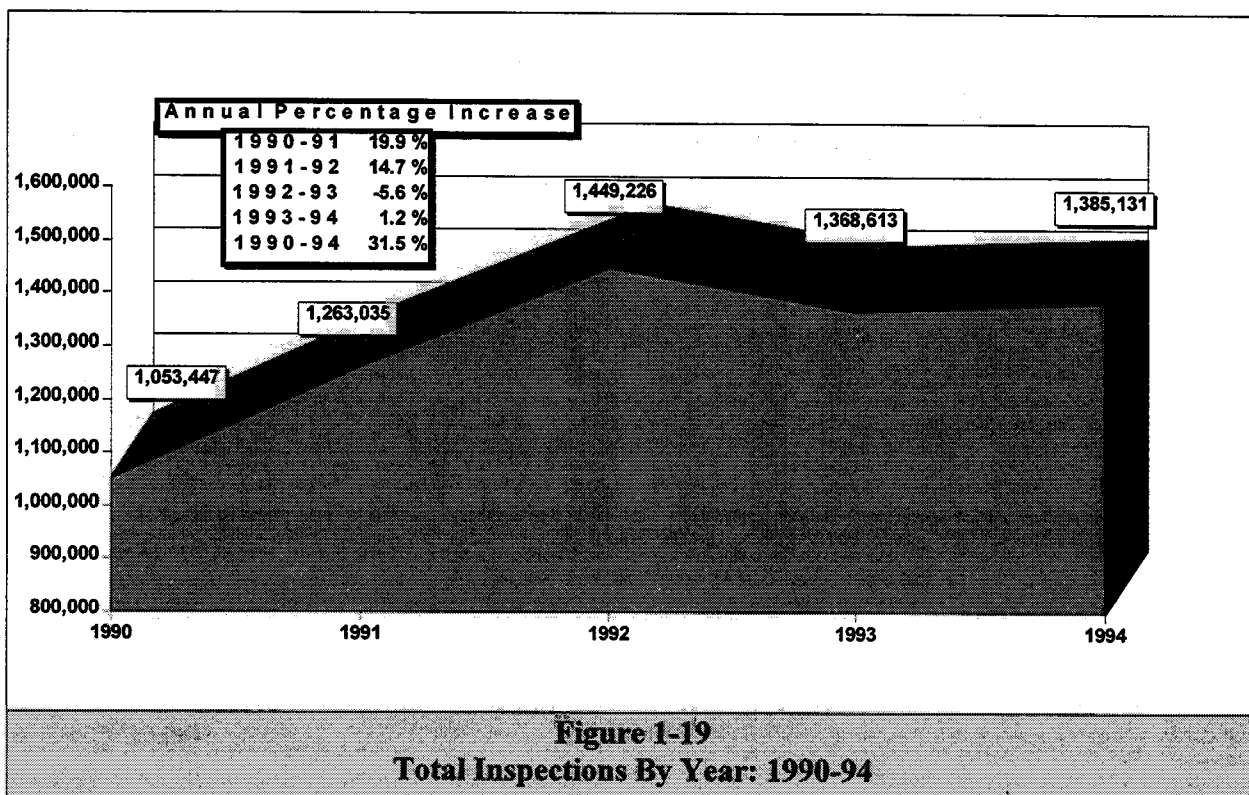
FIVE-YEAR TRENDS

During the five-year period, 1990-94, 6.5 million inspections of interstate carriers were conducted. Total annual inspections performed increased 32 percent, from under 1.1 million in Calendar Year 1990 to almost 1.4 million in Calendar Year 1994 (Figure 1-19). Annual inspection activity increased at a much slower pace during the period 1992-94 than during 1990-92. The number

of inspections completed in 1994 increased by 1.2 percent over the 1993 totals.

Figures 1-20 and 1-21 compare the raw counts of violations and OOS violations by year. The trend lines show that the incidence of violations increased at a much slower pace than the frequency of inspections, and that the incidence of OOS violations actually declined. For the five-year period, 1990-94, inspection activity increased by 32 percent, while detection of violations went up by only 12 percent and detection of OOS violations declined by 13 percent.

The general trend becomes more apparent when the violation and OOS violation rates are compared for the five-year period (Figure 1-22). Both the violation and OOS violation rates had already peaked, in 1990, at 293 and 75, respectively, per 100 inspections. By 1994, the rates had declined to 250



violations, and 50 OOS violations, per 100 inspections. One possible explanation for this trend is that recent public and private initiatives to improve the safety fitness of commercial vehicles were having a positive impact on inspection outcomes. The data presented here, however, are not adequate to definitively support—or refute—this conclusion.

Figure 1-23 examines the ratio of total violations to OOS violations. Here, the trend was in the direction of a decided improvement in the ratio: in 1990, 1 out of every 3.9 violations resulted in an out-of-service citation; by 1994, only one in 5.0 violations produced an out-of-service citation.

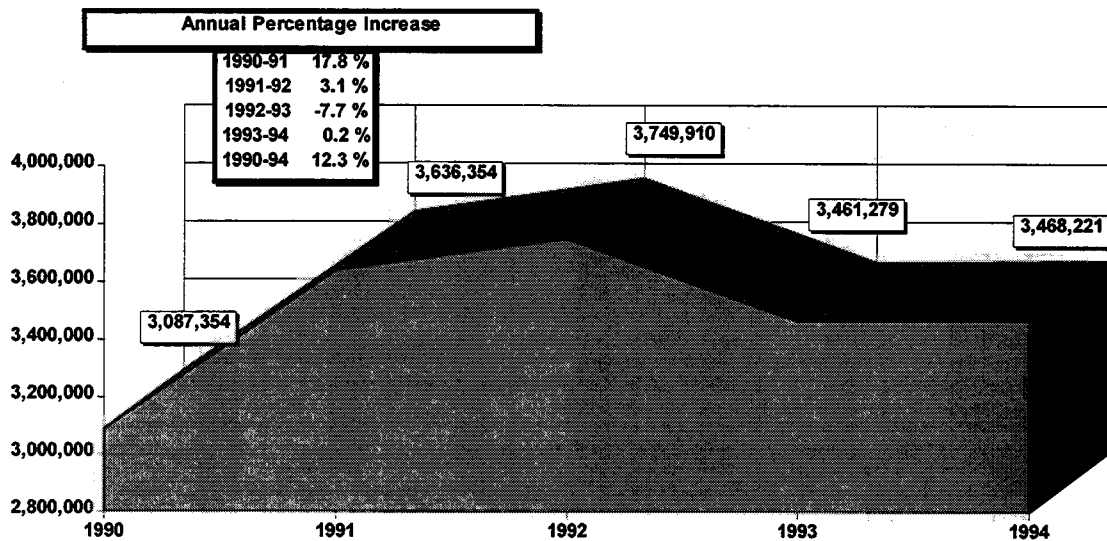


Figure 1-20
Violation Counts By Year: 1990-94

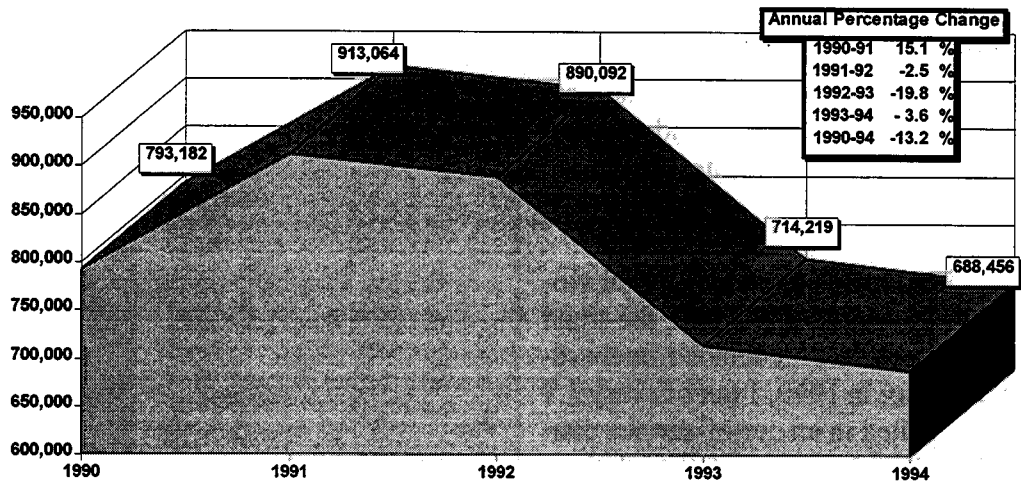


Figure 1-21
Out-of-Service Violation Counts
By Year: 1990-94

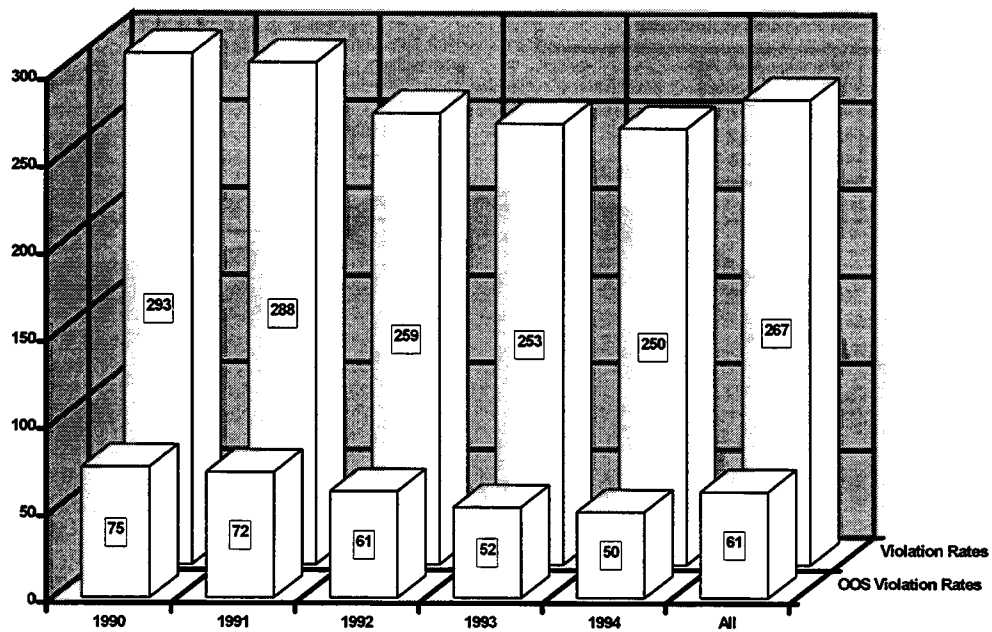
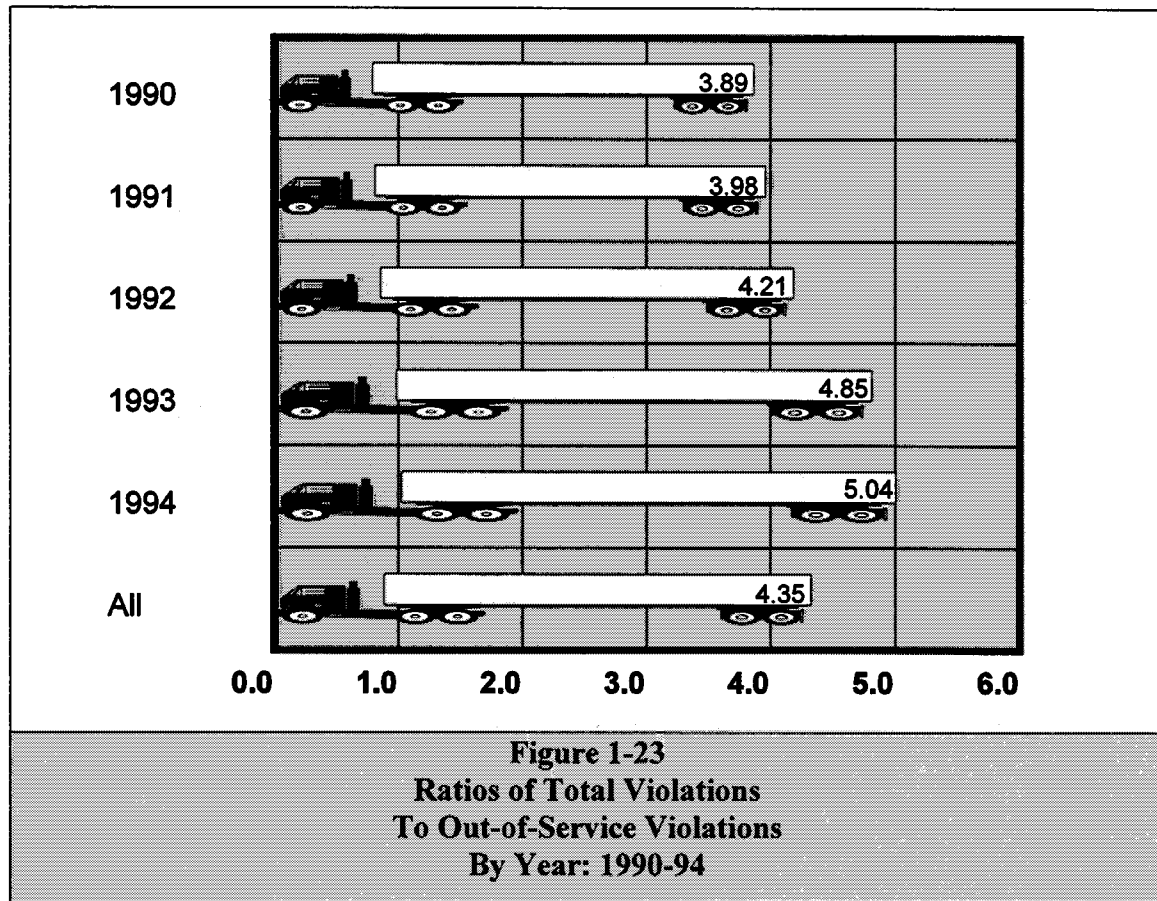


Figure 1-22
Violation and OOS Violation Rates per 100 Inspections
By Year: 1990 - 94



CHAPTER 2

The Impact of Carrier and Vehicle Attributes

Carrier Summary
Carrier Type
Fleet Size
Vehicle Configuration
Hazardous Materials

Nearly 9 out of 10 inspections of interstate carriers performed in 1994 were attributable to "known" carriers. Of the known carriers, 86 percent were inspected 10 or less times each during the year, and 3 percent had over 50 inspections apiece; the average carrier was inspected 9 times during the year. Three of 4 inspections where carrier type was discernible involved for-hire carriers, and 1 of 2 inspections where fleet size was known consisted of carriers operating 38 power units or less. In general, there was a strong inverse relationship between carrier fleet size and inspection outcomes—larger carriers had consistently lower violation rates than did smaller carriers. Three of 4 inspections involved tractor-trailers, mostly singles; vehicle violation rates for singles were slightly lower than those for doubles, while driver violation rates for singles were higher than those for doubles or triples. Buses, by far, had the lowest violation rate of any vehicle group—whereas the violation rate for all vehicle types was 250 per 100 inspections, the rate for buses was 127. In 1 in 10 inspections, the vehicle was transporting hazardous materials at the time of the inspection; the overall violation rate for vehicles transporting hazardous materials was substantially lower than the rate for inspections where hazardous materials were not present.

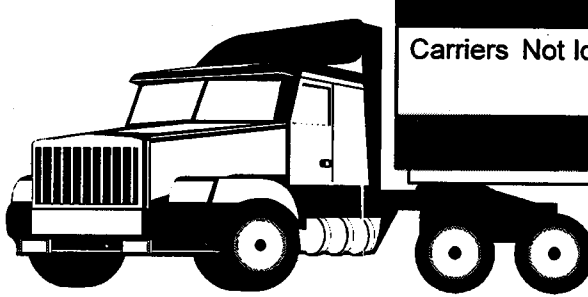
CARRIER SUMMARY

Eighty-seven percent of all interstate inspections conducted in 1994 were attributable to specific carriers; the OMC was not able to identify, positively, the carriers associated with 13 percent of the inspections (Table 2-1). Inspections in which carriers were clearly identified involved more than 129,000 distinct trucking entities, meaning that identified carriers were inspected an average of nine times each over the course of the entire year (Table 2-2). During the year, each identified carrier was cited for an average of 23 violations and five OOS violations (Table 2-3). Figure 2-1 summarizes the breakout of violations per carrier among the three defect groups (vehicle, driver, and hazardous materials).

Table 2-4 shows a frequency distribution of inspection activity among the 129,000 companies identified by the OMC. Eighty-six percent of the carriers were inspected one to ten times in 1994. Less than three percent of all carriers were inspected over 50 times, while 0.5 percent of the carriers were inspected over 200 times.

Figure 2-2 compares two sets of inspection outcomes: (1) inspections where the OMC clearly identified the carriers involved, and

Table 2-1
1994 Inspections by Carrier Identification



	Number	Percent
Carriers Identified	1,211,629	87
Carriers Not Identified	173,502	13

Table 2-2
Inspections by Known Carriers

	Number
Number of Inspections	1,211,629
Number of Carriers	129,027
Average Inspections per Carrier	9.4

Table 2-3
Violations by Known Carriers

	Number
Number of Violations	2,935,384
Number of OOS Violations	582,808
Number of Carriers	129,027
Average Violations per Carrier	22.8
Average OOS Violations per Carrier	4.5

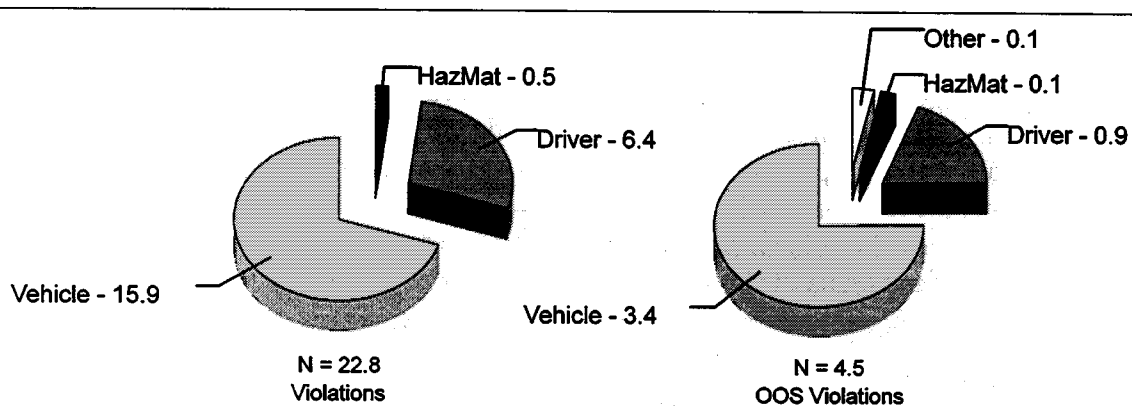


Table 2-4
Inspection Activity
Frequency

Number of Inspections	Frequency
1 to 10	85.9%
11 to 25	8.1%
26 to 50	3.2%
51 to 75	1.1%
76 to 100	0.5%
101 to 200	0.7%
201 to 500	0.4%
Over 500	0.1%
All	100.0%

(2) inspections where the carriers could not be identified. The violation rate for the group of "identified" carriers was significantly lower (242 per 100 inspections) than the rate for the "unidentified" carriers (307 per 100 inspections). The OOS violation rate was also different—48 per 100 inspections for "identified" carriers versus 61 for "unidentified" carriers. In other words, the population of obscure, hard-to-identify carriers experienced, on average, 27 percent more violations per inspection than did the group of "identified" carriers.

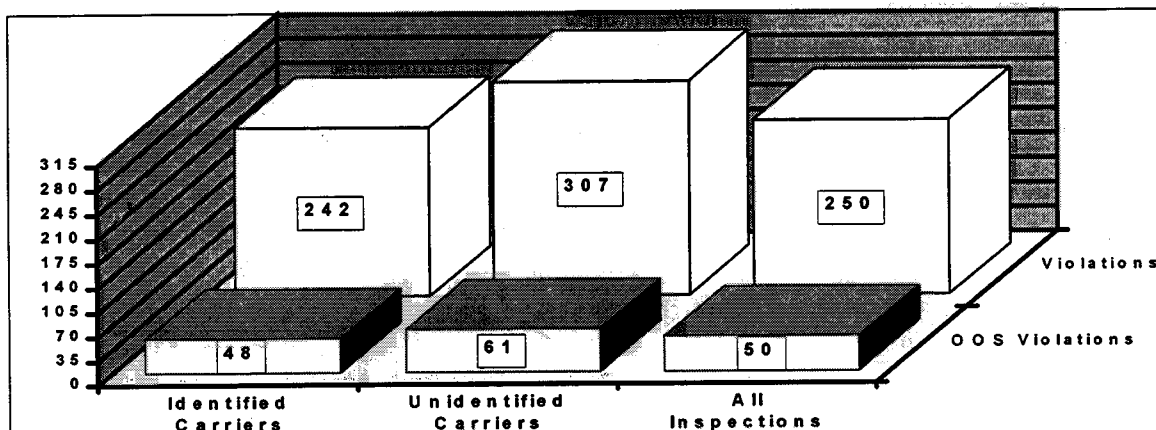


Figure 2-2
Violation Rates Per 100 Carriers
Known vs. Unknown Carriers

Table 2-5
Inspections by Carrier Type
Known Carriers

	Number	Percent
For-Hire Authorized	865,060	71.4%
For-Hire Exempt	38,114	3.1%
Private	270,021	22.3%
Both For-Hire and Private	30,009	2.5%
Other	8,405	0.7%
Total Inspections	1,211,629	100.0%

CARRIER TYPE

Of the 1.2 million inspections in which carriers were identified, three out of every four (74.5 percent) involved for-hire carriers (Table 2-5). Most of the remaining inspections (22.3 percent) involved private carriers. A relatively small number of the carriers (2.5 percent) were designated by the OMC as "both for-hire and private."

Figure 2-3 shows a breakout of the popula-

tion of identified carriers inspected in 1994. More than one-half (52 percent) of all the inspected carriers were private and less than two-fifths (38 percent) were authorized for-hires. Yet, as seen in Table 2-5, over three times as many inspections involved authorized for-hire carriers as private carriers. Hence, at first glance, it appears that authorized for-hire carriers had a much higher probability of being inspected than private carriers.

What initially appears as a higher probability, however, turns out not to be the case at all. Perhaps authorized for-hire carriers amassed the highest proportion of inspections not because of inherent biases in the safety inspection process, but, rather, because the authorized carriers were "exposed" to the possibility of being inspected more often than any of the

other carrier types. One way to test this hypothesis is to consider the extent to which authorized for-hire carriers were on the highway—as measured by vehicle miles of travel (VMT)—relative to the other carrier types.

Table 2-6 reveals that the authorized for-hire carriers inspected in 1994 had an average fleet size of 33 vehicles per carrier, average VMT of 72,000 miles per vehicle, and average total VMT of 2.4 million miles per carrier. This contrasts with private carriers which had an average fleet size of 13 vehicles per carrier, average VMT of 49,000 miles per vehicle, and average total VMT of 0.7 million miles per carrier.

Data from Figure 2-3 and Table 2-6 were

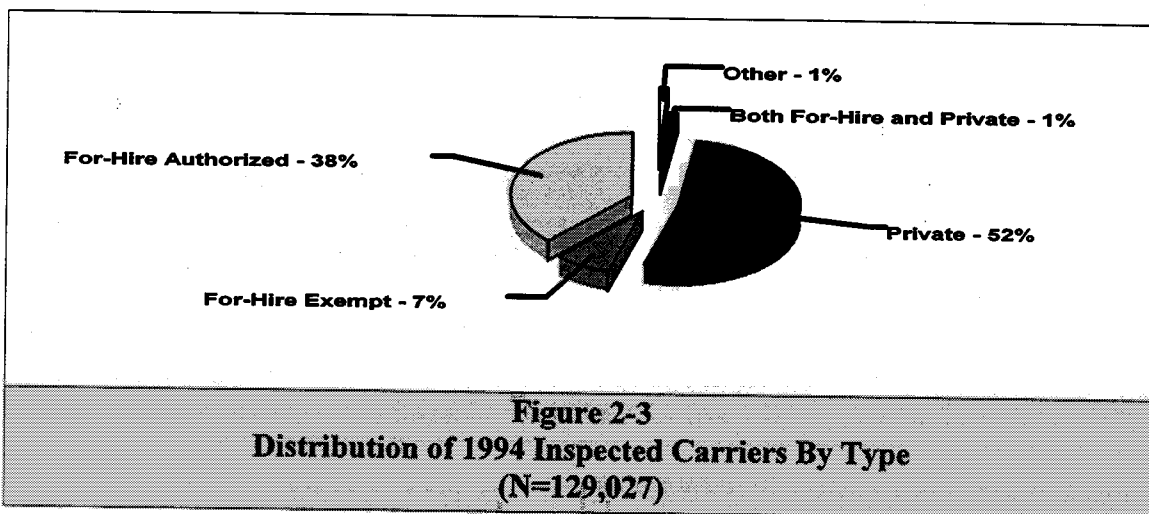


Table 2-6 Average Fleet Size, Per Unit VMT, and VMT Per Carrier By Carrier Type Known Carriers Inspected in 1994 (N=110,743)					
	For-Hire Authorized	For-Hire Exempt	Private	Both For-Hire & Private	Other
Mean No. of Power Units in Fleet	32.64	17.34	13.38	17.21	9.64
Mean VMT per Power Unit	72,276	57,325	48,725	57,147	47,425
Mean VMT per Carrier Fleet	2,359,089	994,016	651,941	983,500	457,177

used, in Table 2-7, to calculate *expected* 1994 inspection frequencies by carrier type. The expected frequencies were then compared to the *experienced* values (from Table 2-5). Based on these data, approximately 67 percent of all 1994 inspections were "expected" to involve authorized for-hire carriers; 26 percent were "expected" to involve private carriers. In practice, 71 percent of the 1994 inspections involved authorized for-hire carriers, while 22 percent involved private carriers. In other words, contrary to initial observations, the data indicate that the distribution of carrier type among 1994 inspected carriers came relatively close to reflecting the distributions among the carrier population at large. If anything, authorized for-hire carriers appeared to be slightly over-represented in inspections, while private carriers were somewhat under-represented.

Table 2-8 summarizes 1994 violation counts—and OOS violation counts—by carrier type. Figures 2-4 through 2-7 then compare the violation and OOS violation rates by carrier type. The comparison of rates for hazardous material violations in Figure 2-7 is limited to those inspections where hazardous materials were present.

There appeared to be generally meaningful differences in the violation rates of the different carrier types. Initially, one might have conjectured that these differences were more a function of fleet size than carrier type. For example, exempt for-hire carriers (average fleet size: 17 power units) experienced 290 violations per 100 inspections versus 238 violations per 100 inspections for authorized for-hire carriers (average fleet

Table 2-7
Inspection Frequencies By Carrier Type
Expected vs. Experienced Values

	For-Hire Authorized	For-Hire Exempt	Private	Both For-Hire & Private	Other	Total
Carrier Representation in Population	38.1%	7.4%	52.4%	0.9%	1.2%	100.0%
Mean VMT per Carrier (000)	2,359	994	652	984	457	
Proportional VMT (000)	899	74	342	9	5	1,329
Inspection Proportion -- Expected	67.6%	5.6%	25.7%	0.7%	0.4%	100.0%
Inspection Proportion -- Experienced	71.4%	3.1%	22.3%	2.5%	0.7%	100.0%

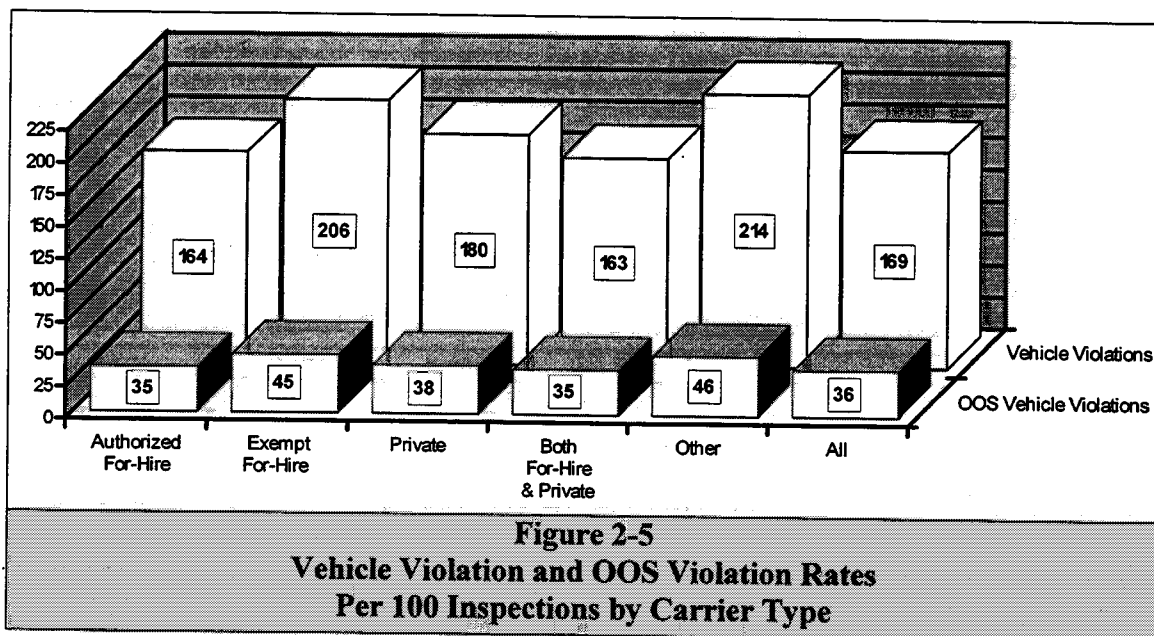
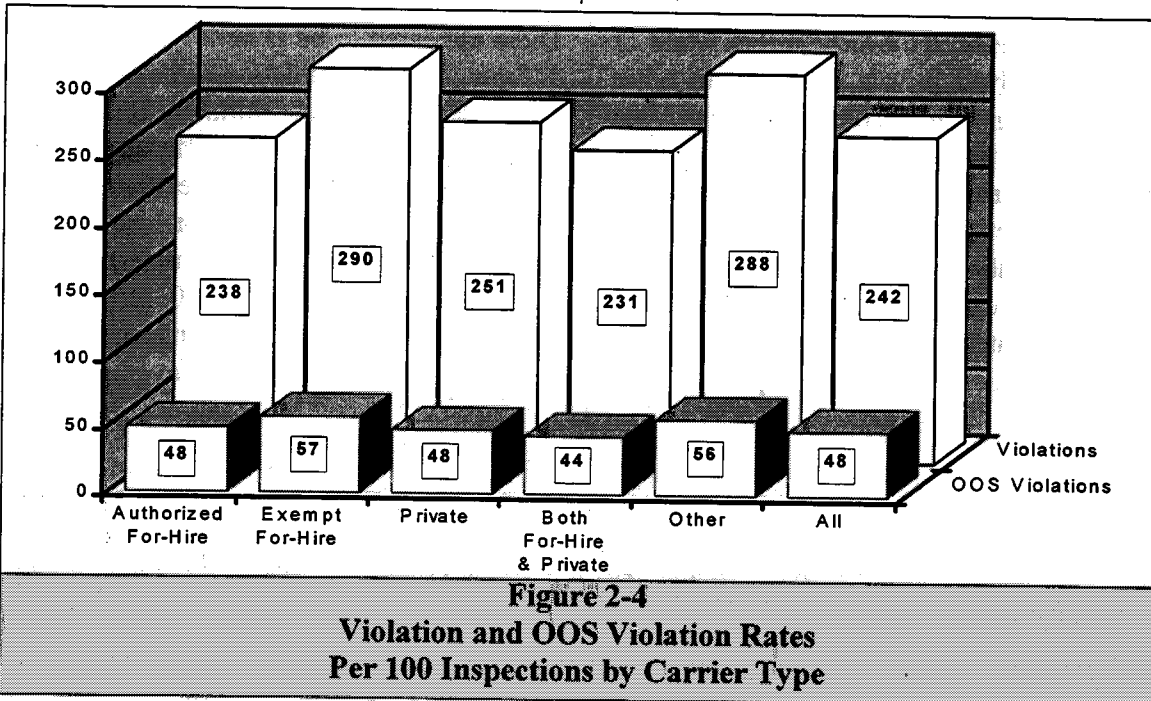
Table 2-8
Violation and OOS Violations
By Carrier Type

	Known Carriers			
	Violations		OOS Violations	
	Number	Percent	Number	Percent
For-Hire Authorized	2,054,652	70.0%	414,865	71.2%
For-Hire Exempt	110,488	3.8%	21,575	3.7%
Private	676,841	23.1%	128,578	22.1%
Both For-Hire & Private	69,180	2.4%	13,085	2.2%
Other	24,223	0.8%	4,705	0.8%
Total Violations	2,935,384	100.0%	582,808	100.0%

size: 33 power units) (Figure 2-4). Private carriers (average fleet size: 13 power units) experienced more total violations—251 per 100 inspections—but the same number of OOS violations—48 per 100 inspections—as authorized for-hire carriers. While the vehicle and hazardous materials violation rates (Figures 2-5 and 2-7, respectively)

were higher for private carriers than for authorized for-hire carriers, the driver violation rate (Figure 2-6) was actually lower for private carriers—63 violations per 100 inspections versus 69 violations for authorized for-hire carriers.

Interestingly, it was the group of carriers



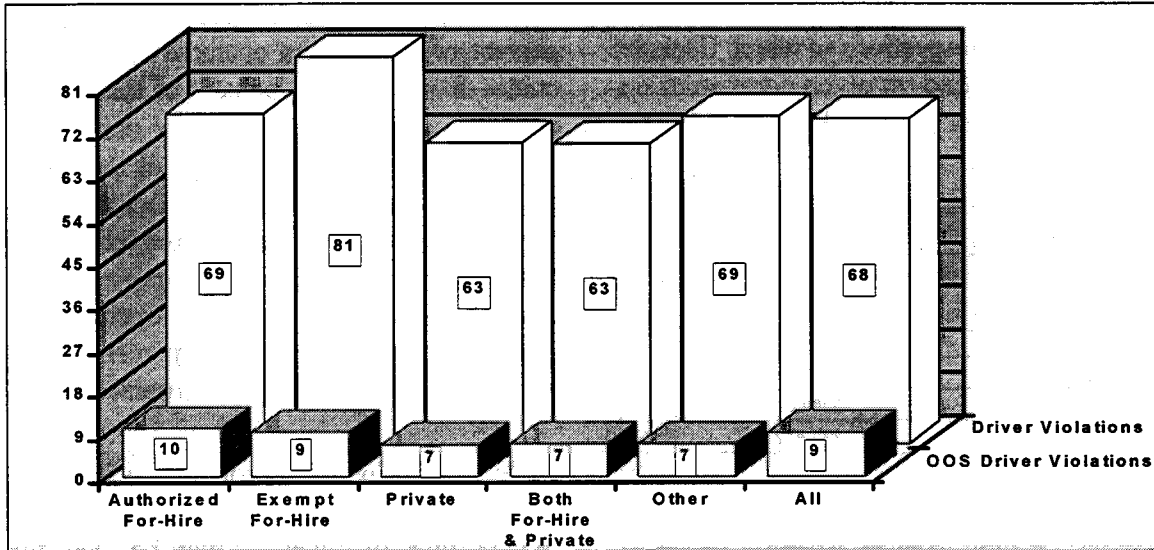


Figure 2-6
Driver Violation and OOS Violation Rates
Per 100 Inspections by Carrier Type

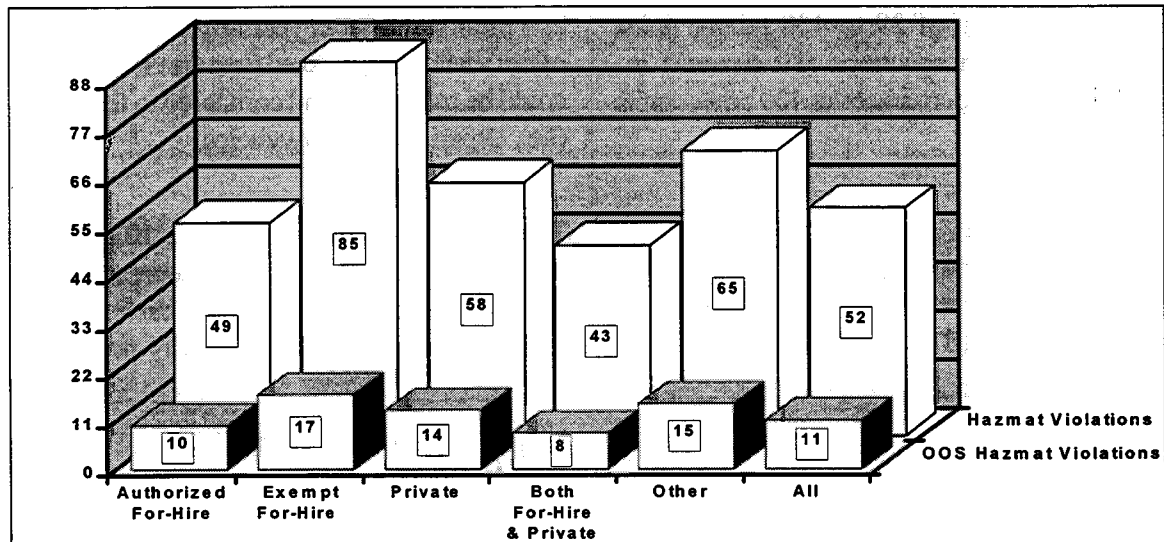


Figure 2-7
Hazardous Materials Violation and OOS Violation Rates
Per 100 Hazardous Materials Inspections by Carrier Type

characterized as "both for-hire and private" (average fleet size: 17 vehicles) which consistently performed as well as, or better than, the authorized for-hire carriers. In general, the "both for-hire and private" group experienced five percent fewer violations—and 9 percent fewer OOS violations—than all the other car-

rier groups combined.

FLEET SIZE

Carrier fleet size—measured as a count of total power units owned or operated—was discernible for more than 1.1 million 1994 inspec-

tions. As shown in Table 2-9, one-half (51 percent) of all inspections in which fleet size could be identified involved companies operating 38 power units or less. Nearly one-

Table 2-9
Inspections By
Fleet Size

Fleet Size	Number	Percent
1 to 11	338,634	30.2%
12 to 38	227,452	20.3%
39 to 400	347,793	31.0%
401 to 2,000	141,380	12.6%
2,001 to 5,000	39,304	3.5%
Over 5,000	27,590	2.5%
Total	1,122,153	100.0%

third (31 percent) of the inspections entailed carrier operation of 39 to 400 power units. The remaining inspections (19 percent) involved carriers operating over 400 power units each.

Figure 2-8 offers a breakout of carriers inspected during the year where fleet size was known. The overwhelming majority of inspected carriers (81 percent) owned or oper-

ated 11 power units or less, while only 6 percent of the carriers operated 39 or more units—fewer than 0.4 percent of the carriers operated more than 400 power units. Indeed, a precursory comparison of the information in Figure 2-8 and Table 2-9 brings to mind the types of patterns observed in the preceding section on carrier type—81 percent of the carriers inspected operated 11 vehicles or less, but only 30 percent of all inspections involved those carriers!

Table 2-10 helps sort through this issue by examining each fleet size category in terms of vehicle miles of travel. It may be seen, for example, that the smallest carriers (1-11 power units) traveled an average of 180,000 miles per year, whereas the largest companies (over 5,000 power units) each averaged more than 257 million miles per year. By taking account of the VMT, the expected fleet size frequencies could be calculated and compared to the actual (i.e., experienced) frequencies.

The analysis presented in Table 2-10 suggests that small carriers were over-represented in 1994 inspections and that large carriers were under-represented. This disparity was most

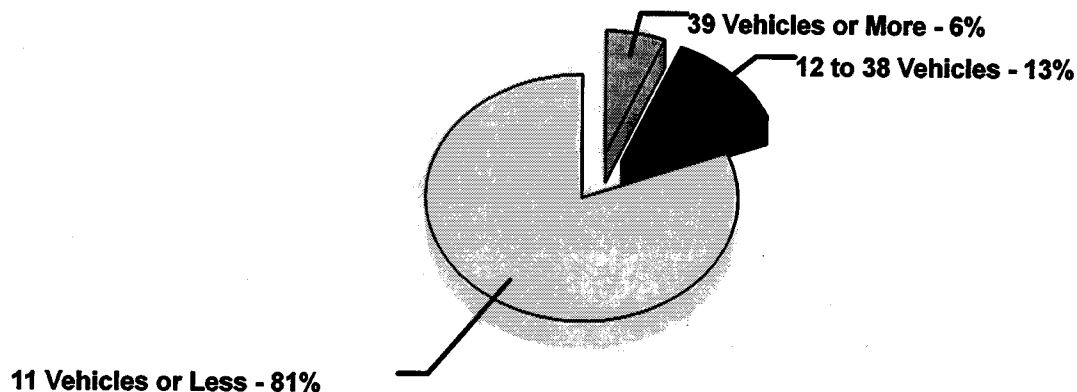


Figure 2-8
Distribution of 1994 Inspected Carriers
By Fleet Size
(N = 108,238)

Table 2-10
Inspection Frequencies By Fleet Size
Expected Vs. Experienced Values

	Power Units						
	1 to 11	12 to 38	39 to 400	401 to 2,000	2,000 to 5,000	Over 5,000	Total
Carrier Representation In Population	80.95%	13.38%	5.28%	0.34%	0.03%	0.02%	100.0%
Mean VMT per Carrier (000)	180	1,198	6,429	45,474	157,487	257,442	
Proportional VMT (000)	146	160	339	155	48	51	899
Inspection Proportion – Expected	16.2%	17.8%	37.7%	17.2%	5.3%	5.7%	100.0%
Inspection Proportion – Experienced	30.2%	20.3%	31.0%	12.6%	3.5%	2.5%	100.0%

pronounced for fleets of 1-11 power units, where nearly twice as many carriers were selected for inspection as was predicted by carrier representation on the nation's highways. The over-representation continued—though less dramatically—for fleets of 12-38 power units. On the other hand, carriers with fleets of 39 or more power units appeared to have been inspected less often than was predicted by their representation on the highways.

Table 2-11 shows violation and OOS violation counts by fleet size, and Figures 2-9 through 2-12 compare the violation and OOS violation rates. The data in the four figures suggest that there was a strong rela-

tionship between fleet size and inspection outcomes—namely, that as fleet size increased, violation rates decreased. As revealed in Figure 2-9, for example, carriers operating fleets of 1-11 power units experienced, on average, 86 percent more violations than did carriers operating over 5,000 units (288 versus 155 violations per 100 inspections). This basic trend was observed for each of the defect groups—vehicle, driver, and hazardous materials—except that the violation rate for hazardous materials defects (Figure 2-12) was slightly higher for carriers operating 2,001-5,000 power units than carriers with 401-2,000 power units.

Table 2-11
Violations and OOS Violations
By Fleet Size

Fleet Size	Violations	Percent	OOS Violations	Percent
1 to 11	974,186	36.3%	192,988	36.3%
12 to 38	577,465	21.5%	115,849	21.8%
39 to 400	759,111	28.3%	150,402	28.3%
401 to 2,000	259,596	9.7%	50,974	9.6%
2,001 to 5,000	67,749	2.5%	13,228	2.5%
Over 5,000	42,788	1.6%	7,949	1.5%
Total	2,680,895	100.0%	531,390	100.0%

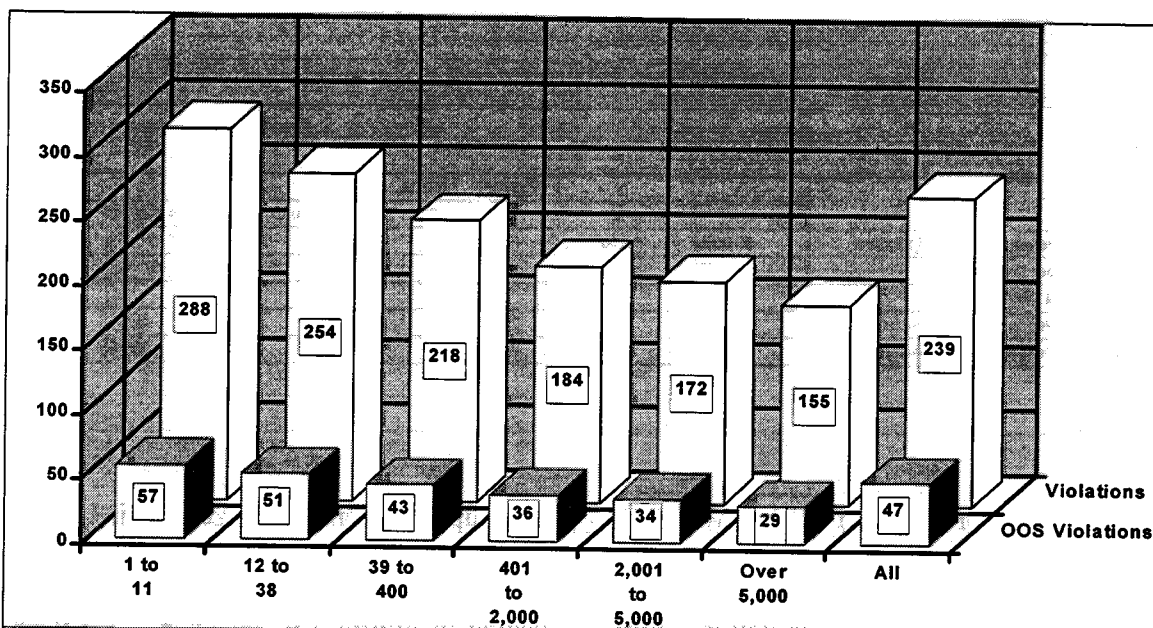


Figure 2-9
Violation and OOS Violation Rates
Per 100 Inspections by Fleet Size

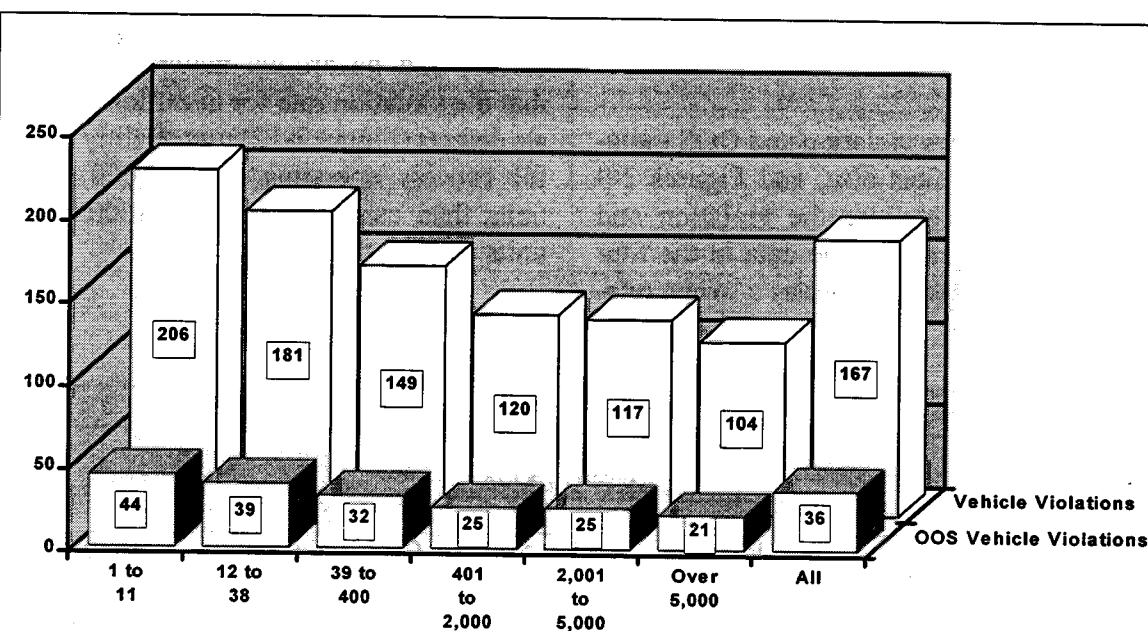


Figure 2-10
Vehicle Violation and OOS Violation Rates
Per 100 Inspections by Fleet Size

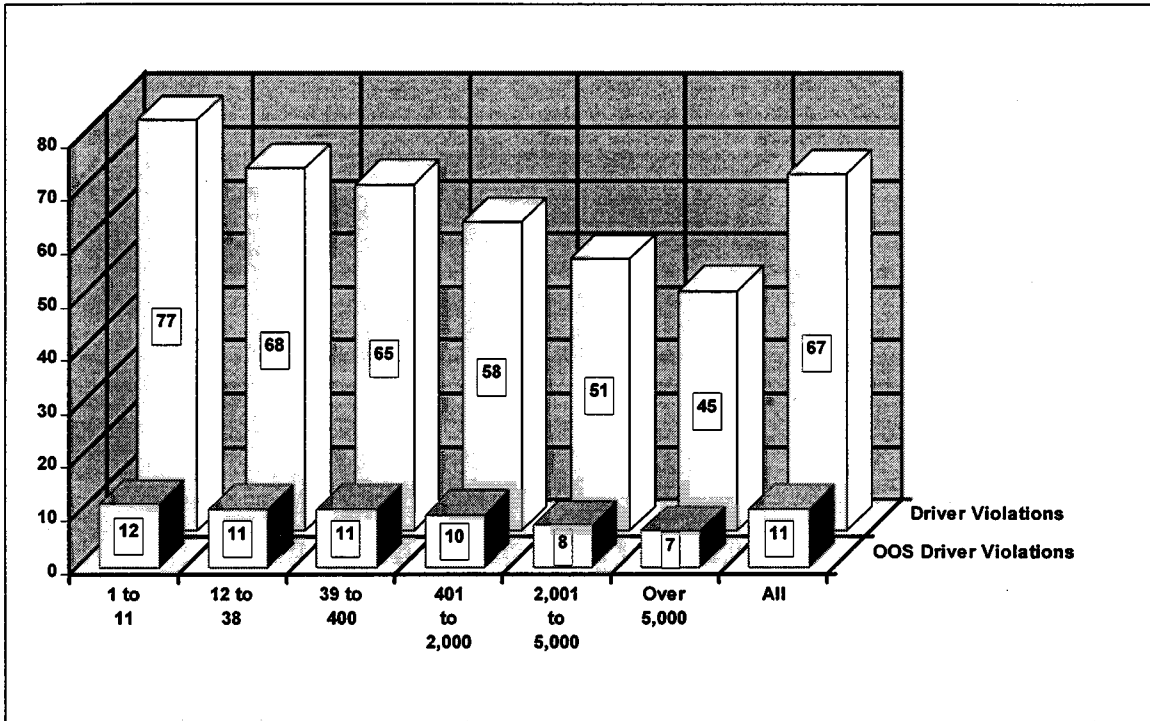


Figure 2-11
Driver Violation and OOS Violation Rates
Per 100 Inspections
By Fleet Size

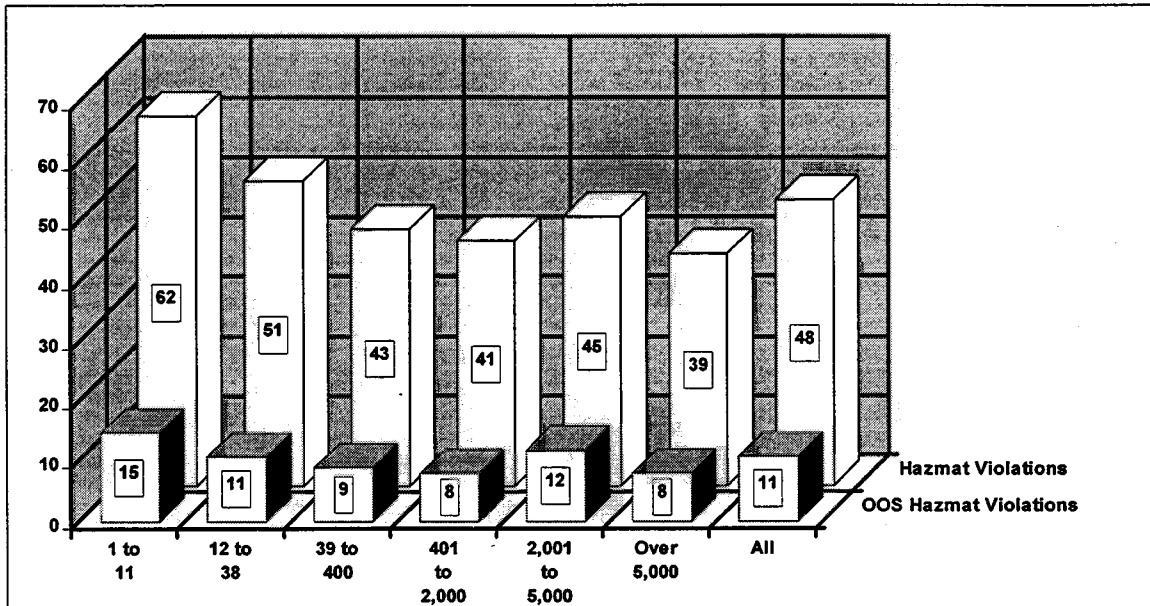


Figure 2-12
Hazardous Materials Violation and OOS Violation Rates
Per 100 Hazardous Materials Inspections
By Fleet Size

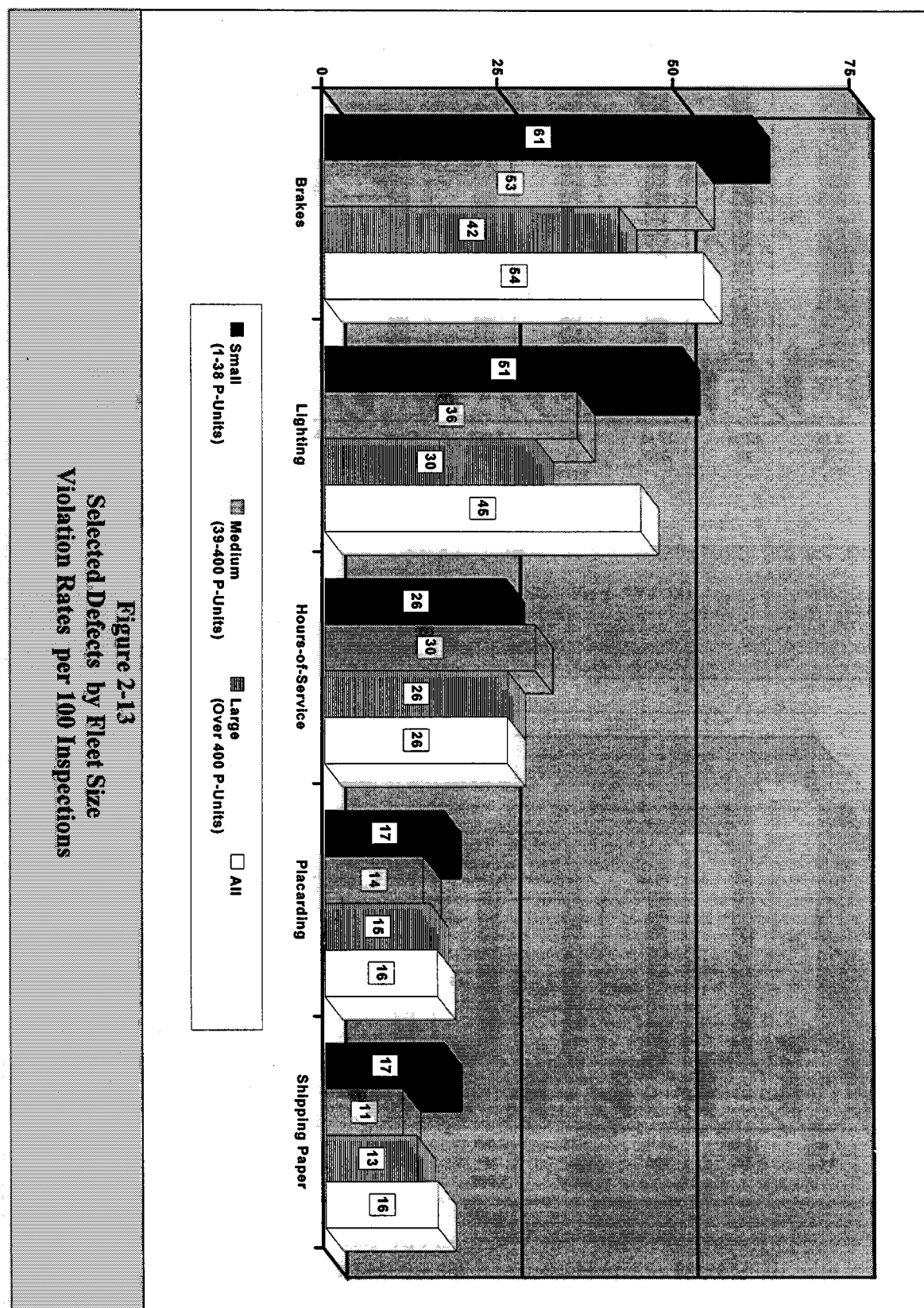


Figure 2-13 breaks carrier fleet size into three categories—small, medium, and large—and examines the corresponding violation rates for specific vehicle, driver, and hazardous materials defects. From this figure, it can be inferred that fleet size had a significant impact on the identification of brake and lighting violations, little or no impact on hour-of-service violations, and marginal impact on violations resulting from improper placarding and improperly-prepared shipping papers. (For the two hazardous materials defects, small carriers experienced more violations than the other groups, but medium-sized carriers performed slightly better than large carriers.) In other words, this display implies that while fleet size had a profound impact on overall inspection outcomes, the results were more mixed when individual defects were considered.

In summary, the data on fleet size support two conclusions: (1) smaller carriers were over-represented in 1994 inspections; and (2) the violation rates for smaller carriers were usually higher than the rates for larger carriers. These findings, taken together, suggest that over-representation of smaller carriers may actually have been desirable and, perhaps, even beneficial. Since comparatively more defects were discovered during inspections of vehicles from smaller fleets, the controlled "over-sampling" of small-fleet vehicles likely resulted in the removal of a larger number of unfit vehicles and drivers from the roadways than would have been the case without the over-representation.

VEHICLE CONFIGURATION

Vehicle *configuration*—that is, arrangement of the individual units (tractors, trailers, etc.) comprising a given vehicle—is identified at the outset of each inspection. In this report, the various configurations are grouped into seven

common categories, as follows:

Tractor-Only. A self-propelled commercial truck-tractor with no additional unit, such as a trailer or other cargo box, attached. Normally, a vehicle in this configuration has already delivered its load and is returning to the point of origin for new assignments.

Straight Truck. A commercial vehicle in which the power unit and cargo box are non-detachable.

Tractor-Trailer/Single. A commercial vehicle consisting of a truck-tractor and detachable trailer. Normally, the trailer in this configuration is a "semi-trailer."

Tractor-Trailer/Double. A commercial vehicle consisting of a truck-tractor and two detachable trailers. Normally, the first trailer is a semi-trailer and the second is a "full trailer." (A semi-trailer can be made to function as a full trailer using a device called a "dolly converter.")

Tractor-Trailer/Triple. A commercial vehicle consisting of a truck-tractor and three detachable trailers. Normally, the first trailer is a semi-trailer and the second and third are full trailers.

Bus. A commercial vehicle designed and used to transport passengers.

Other. A commercial vehicle which does not fit any of the configurations described above. Examples include a tow vehicle pulling a commercial vehicle, a truck-tractor "piggy-backed" on another truck-tractor, two buses attached, etc. This category also includes "unknown" configurations which could not be definitively identified after the inspection was completed.

The vehicle configurations described above are graphically depicted in the Appendix.

Table 2-12
Inspections by
Vehicle Configuration

Configuration Type	Number	Percent
Tractor-Only	59,334	4.3%
Straight Truck	215,865	15.6%
Tractor-Trailer/Single	1,044,594	75.4%
Tractor-Trailer/Double	24,358	1.8%
Tractor-Trailer/Triple	559	0.0%
Bus	19,368	1.4%
Other	21,053	1.5%
Total	1,385,131	100.0%

As shown in Table 2-12, the vast majority of vehicles (75 percent) inspected in 1994 were tractor-trailers/singles. This was followed by straight trucks at 16 percent. Less than 2 percent of all inspections involved doubles or triples, and just over one percent involved buses.

Table 2-13
Violations and OOS Violations
By Vehicle Configuration

Configuration Type	Violations		OOS Violations	
	Number	Percent	Number	Percent
Tractor-Only	103,869	3.0%	19,839	2.9%
Straight Truck	512,283	14.8%	85,895	12.5%
Tractor-Trailer/Single	2,709,105	78.1%	553,317	80.4%
Tractor-Trailer/Double	64,256	1.9%	12,515	1.8%
Tractor-Trailer/Triple	1,249	0.0%	187	0.0%
Bus	24,640	0.7%	3,270	0.5%
Other	52,819	1.5%	13,433	2.0%
Total	3,468,221	100.0%	688,456	100.0%

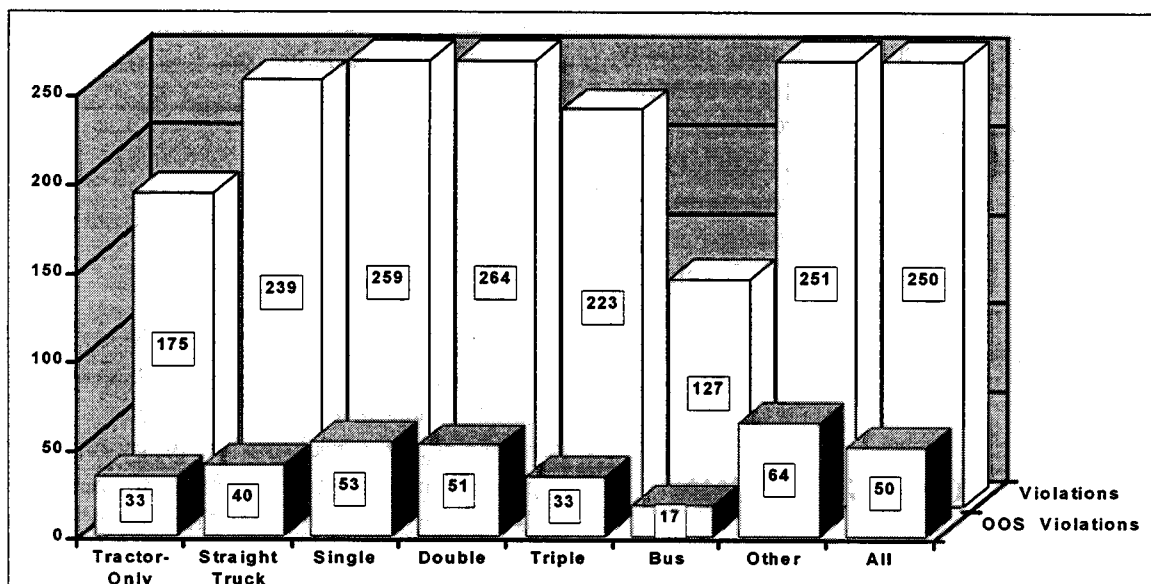


Figure 2-14
Violation and OOS Violation Rates
Per 100 Inspections by Vehicle Configuration

Table 2-13 identifies violation and OOS violation counts by vehicle configuration; Figures 2-14 through 2-17 compare the violation and OOS violation rates. In general, with the exception of triples, the vehicle violation rates tended to increase as configuration lengths increased (Figure 2-15). For instance, among the property-carrying vehicles, tractors-only had the lowest vehicle violation rate (101 per 100 inspections), followed by straight trucks (152), singles (182), and doubles (196), respectively; triples had a vehicle violation rate 178 per 100 inspections. (Among all vehicles—both property- and passenger-carrying—buses had the lowest violation rate overall: 97 per 100 inspections.) However, while the rate differential between tractors-only, straight trucks, and singles was significant, the rate difference between singles and

doubles, was more modest. The pattern still held, though less drastically, when OOS vehicle violation rates were considered: the OOS rate for tractors-only, straight trucks, singles, and doubles was 23, 27, 40, and 43, respectively.

Whereas vehicle violation rates tended to *increase* with configuration length, driver violation rates appeared to *decrease* with length (Figure 2-16). For example, the driver violation rates for straight trucks, singles, doubles, and triples were 73, 71, 57, and 36, respectively. Although information on professional driving experience was not normally collected during inspections, the patterns observed here may well be explained by common suppositions about driver assignments—namely, that the drivers assigned to extremely large vehi-

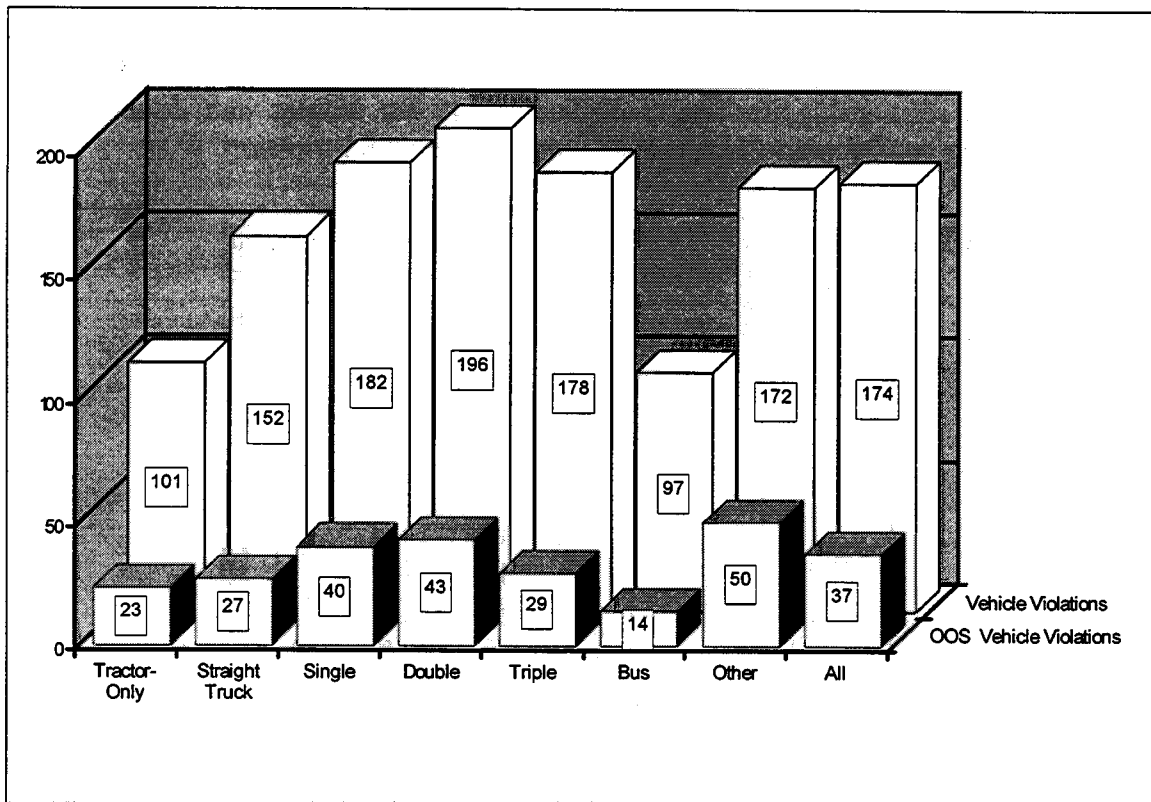


Figure 2-15
Vehicle Violation and OOS Violation Rates
Per 100 Inspections by Vehicle Configuration

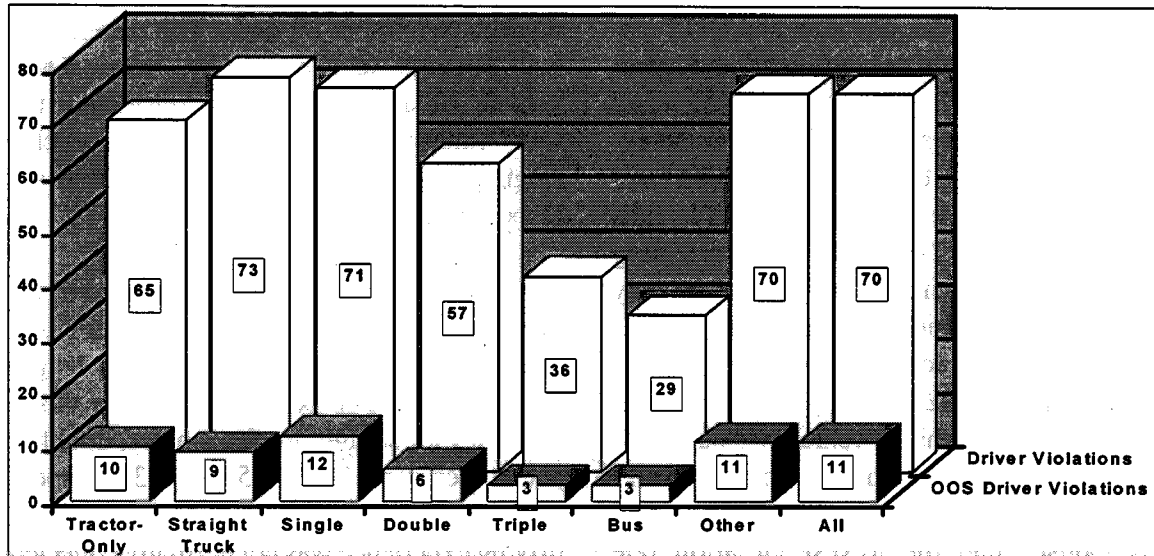


Figure 2-16
Driver Violation and OOS Violation Rates
Per 100 Inspections by Vehicle Configuration

cles (i.e., doubles and triples) have more experience and better safety records than the professional driver population at-large.

A slight inverse relationship also appeared to exist between configuration length and

incidence of hazardous materials violations (Figure 2-17). The hazardous materials violation rate per 100 hazardous materials inspections was 82 for straight trucks, leveled off at 49 for singles and doubles, and dropped to 42 for triples.

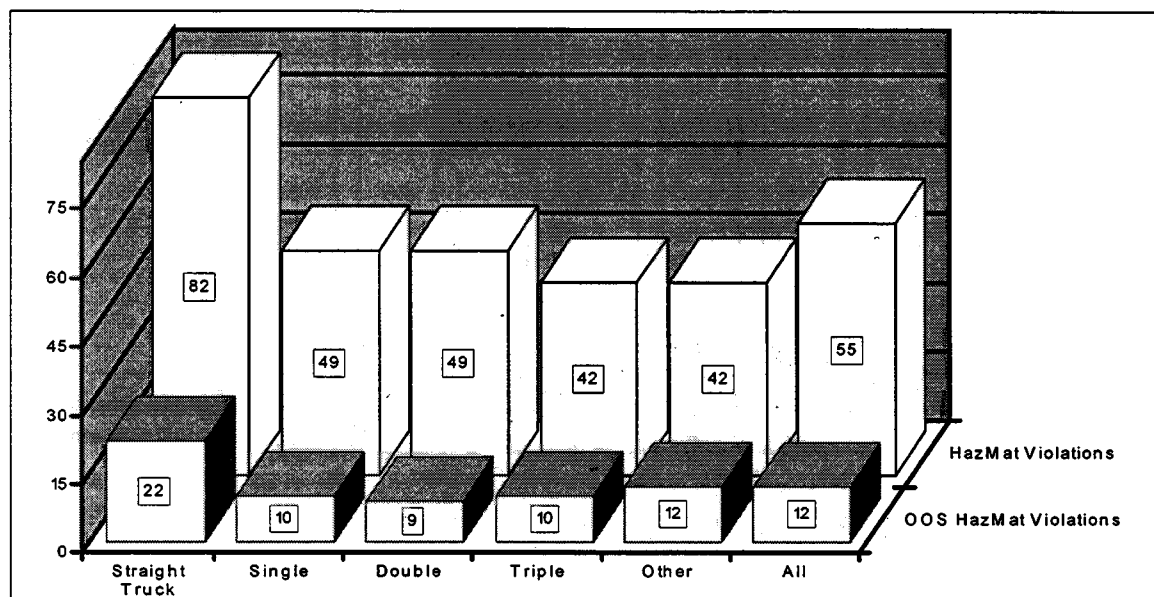


Figure 2-17
Hazardous Materials Violation and OOS Violation Rates
Per 100 Hazardous Materials Inspections by Vehicle Configuration

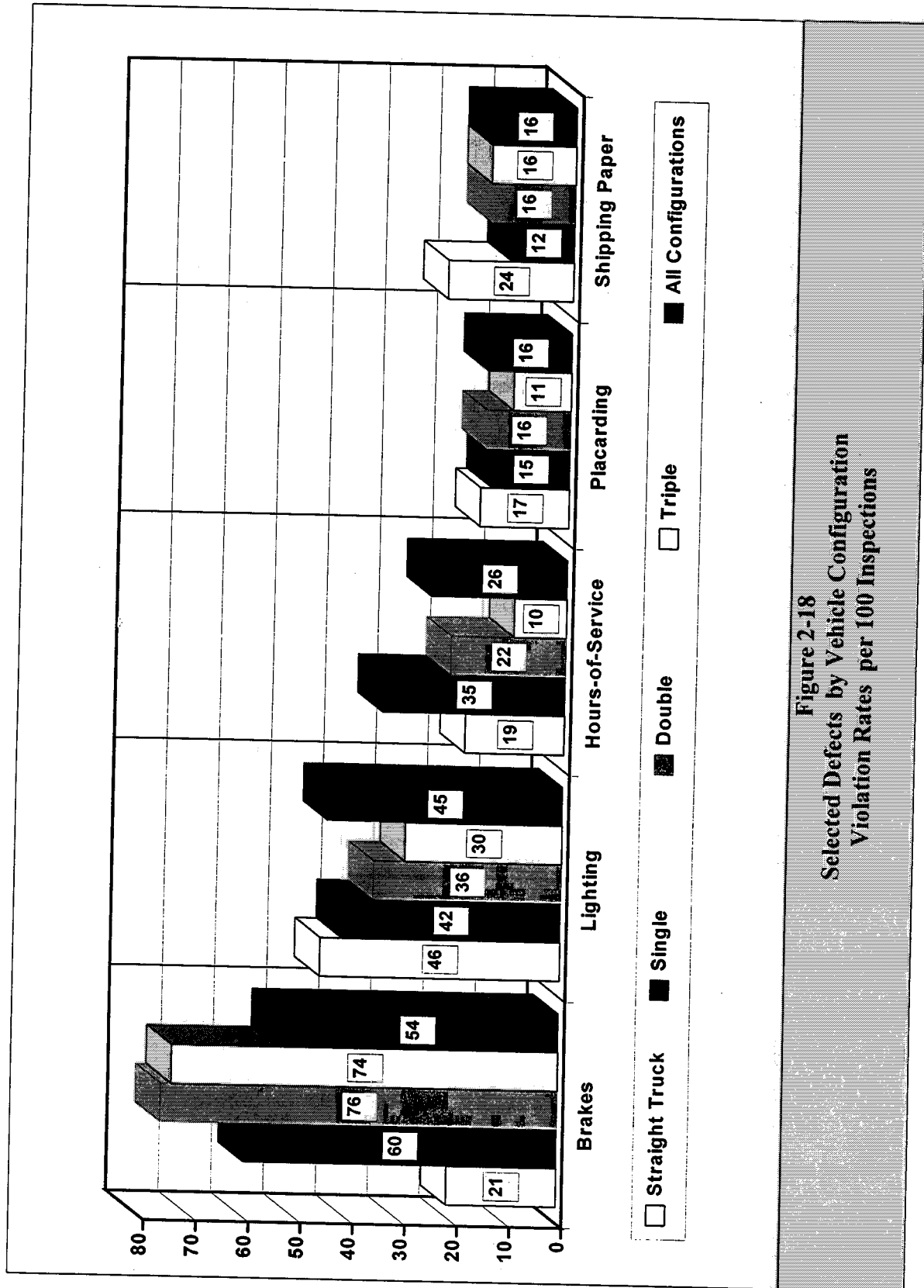


Figure 2-18 reveals that even the most basic patterns, identified above, can be elusive when individual defects are considered. For example, the rate of brake violations *increased* as vehicle configuration lengthened, at the same time that the rate of lighting defects *decreased*. Similarly, the rate of hours-of-service violations conformed with the driver pattern generally—decreasing as configuration length increased—provided that only singles, doubles, and triples were considered. However, when straight trucks were taken into account, the pattern looked quite different—the rate of hours-of-service violations for straight trucks (19 per 100 inspections) was lower than that for singles and doubles (35 and 22, respectively).

HAZARDOUS MATERIALS

What was the relationship between the presence or non-presence of hazardous materials and inspection outcomes? To examine this question, the violation rates for vehicles transporting hazardous materials at the time of the inspection were compared to the rates for vehicles transporting non-hazardous materials only. The focus of the examination was on overall violation rates, and then on vehicle and driver violation rates. Comparisons of rates for hazardous material violations, of course, could not be made between the two sets of inspections.

Approximately 10 percent of all vehicles in-

spected in 1994 were transporting hazardous materials at the time of the inspection (Table 2-14). As shown in Figure 2-19, the overall violation rate when hazardous materials were onboard was 192 per 100 inspections versus 257 per 100 inspections when only non-hazardous materials were onboard. The vehicle violation rate was 109 for hazardous materials versus 181 for non-hazardous materials, and the driver violation rate was 36 for hazardous materials versus 74 for non-hazardous materials. Similar trends were apparent when OOS violation rates were compared.

Figure 2-20 compares violation rates for selected defects. Inspections where hazardous materials were present at the time of the inspection experienced, on average, 36 percent fewer brake violations, 45 percent fewer lighting violations, and 64 percent fewer hours-of-service violations than inspections where only non-hazardous materials were present.

In general, this assessment lends credence to the thesis that vehicles and drivers transporting hazardous materials tended to comply more fully with State and Federal safety regulations than vehicles and drivers transporting non-hazardous materials only. It should be noted, however, that this comparison applies only to individual inspections, and does not address the relative safety fitness of *carriers* of hazardous versus non-hazardous materials.

Table 2-14
Inspection and Violation Counts
By Presence of Hazardous Materials

	Hazardous Materials Onboard Vehicle		Non-Hazardous Materials Only Onboard Vehicle		Total	
	Number	Percent	Number	Percent	Number	Percent
Inspections	134,603	9.7%	1,250,528	90.3%	1,385,131	100.0%
Violations	258,559	7.5%	3,209,662	92.5%	3,468,221	100.0%
OOS Violations	49,779	7.2%	638,677	92.8%	688,456	100.0%

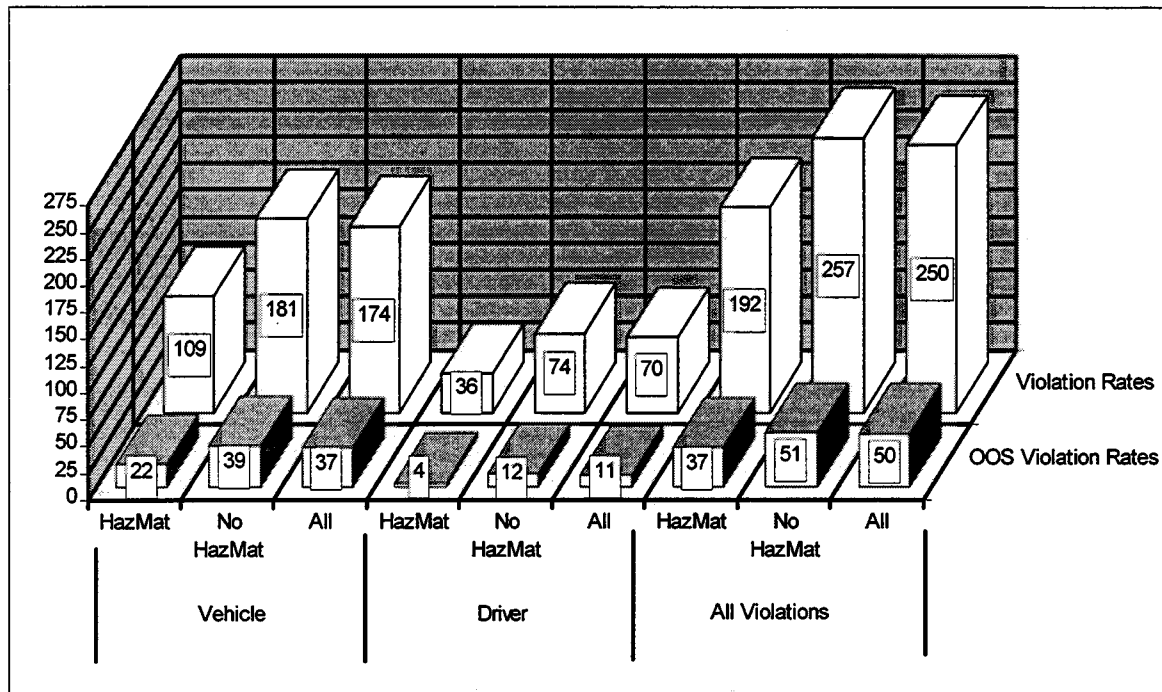


Figure 2-19
Vehicle/Driver Violation and OOS Violation Rates
Per 100 Inspections by Presence of Hazardous Materials

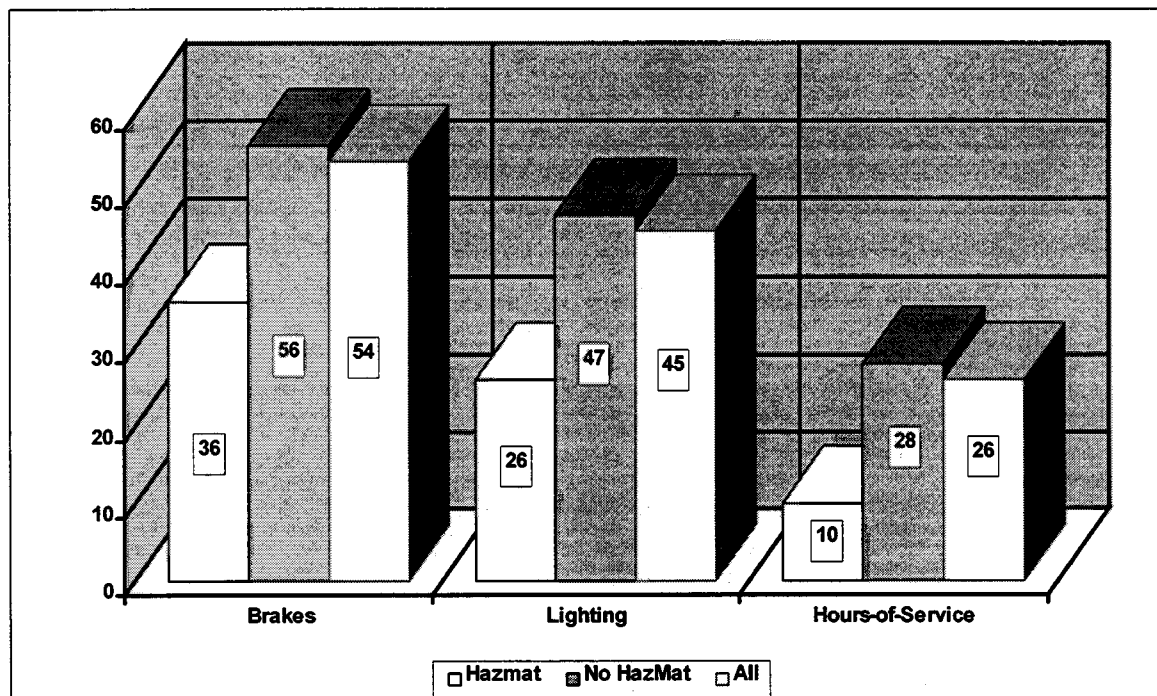


Figure 2-20
Selected Defects by Presence of Hazardous Materials
Violation Rates per 100 Inspections

CHAPTER 3

The Impact of the Inspection Environment

Location
Facility
Season
Time-of-Day
Duration

All States and most U.S. territories participated in the 1994 MCSAP inspection program. States exercised generally broad discretion over how best to structure and prioritize their individual programs. Inspections were variously conducted at *fixed* and *mobile* facilities; inspections at fixed facilities tended to result in higher vehicle violation rates, while inspections at mobile facilities had higher driver and hazardous materials violation rates. Fewer inspections were performed in Winter than during the rest of the year; Winter inspections generally resulted in lower violation rates. Eighty percent of all inspections were conducted between 6AM and 6PM, with the heaviest concentration of activities occurring before

noon; daytime inspections produced higher violation rates than did nighttime inspections. The average inspection was 31 minutes in length; longer inspections resulted in more violations; and Full Inspections, of all the inspection methodologies, produced the highest violation rates per hour of inspection activity.

LOCATION

Seventy percent of all inspections conducted in 1994 involved interstate carriers (Figure 3-1). Nearly all of these inspections were performed by State personnel—a statistically insignificant proportion of the interstate inspections (0.2 percent) were

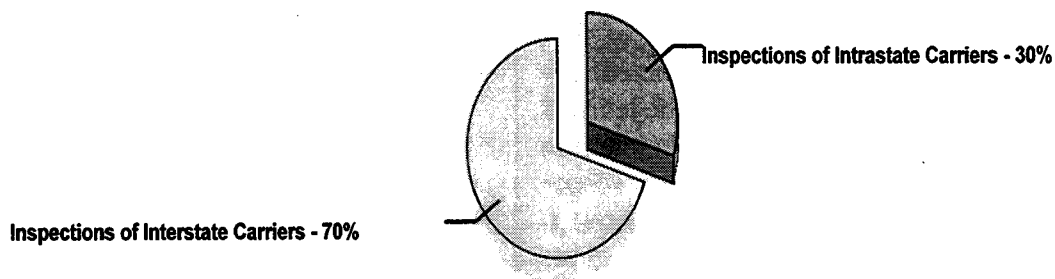


Figure 3-1
Proportion of 1994 Inspections
Involving Non-Interstate Carriers
N=1,976,973

performed by Federal safety investigators.

Tables 3-1 through 3-4 summarize 1994 interstate inspection activity by State location. In reviewing these data, the following factors should be taken into account:

- The data *do not* reflect the 591,842 inspections of intrastate carriers completed in 1994. The data *do*, however, include the 2,475 inspections performed by Federal investigators.
- Two U.S. territories *did not* participate in MCSAP in 1994: Northern Marianas and the Virgin Islands.

Data in the tables for individual States may be compared to the totals for all States to determine State standings against the national norms. For instance, Table 3-2 supports the comparison of violation rates, OOS violation rates, and violation-to-OOS violation ratios. (Remember that lower ratios mean that higher percentages of violations resulted in out-of-service citations.)

Table 3-4 identifies the percentage of inspections in each State which were Full Inspections, and the mean duration of Full Inspections when they were conducted. By studying these tables, much can be learned about individual States' 1994 inspection activities. For example, State-by-State comparisons reveal that higher percentages of Full Inspections (Table 3-4) were—frequently, but not exclusively—associated with lower counts of total inspections (Table 3-1), but higher violation rates per inspection (Tables 3-2 and 3-3).

Even among those States which conducted comparable percentages of Full Inspections (Table 3-4), longer inspection durations tended to correlate positively with higher violation rates (Tables 3-2 and 3-3). The States, clearly, had different perspectives on whether to perform (1) less comprehensive inspections on a larger volume of vehicles, or (2) more comprehensive inspections on fewer vehicles.

FACILITY

Most inspections, in 1994, were conducted at either *fixed* or *mobile* facilities. "Fixed" facilities included scales and other permanent inspection sites. "Mobile" or "roadside" facilities were those which could be easily relocated to different places, as conditions warranted. For example, a mobile inspection facility might be temporarily established along a secondary road near a junction with an interstate highway.

As revealed in Figure 3-2, comparable volumes of inspections were conducted at fixed facilities, (48 percent) versus mobile facilities (45 percent). "Unknown" (7 percent) refers both to (1) facilities which could not be characterized either as fixed or mobile, and (2) facilities which were not identified at all.

Tables 3-5 and 3-6 summarize inspection activity by facility type. As shown in the latter table, 57 percent of all inspections at fixed facilities were Full Inspections, as compared to only 35 percent at mobile facilities. The reverse was true for Walk-Around Inspections—25 percent of all inspections at fixed facilities were Walk-Arounds, as com-

Table 3-1
Inspection, Violation, and OOS Violation Counts
By State

	Number of Inspections	Number of Violations	Number of OOS Violations
Alabama	15,592	43,258	5,540
Alaska	715	1,946	297
American Samoa	145	347	110
Arizona	25,827	106,944	12,833
Arkansas	37,359	76,464	19,300
California	79,016	118,957	29,823
Colorado	32,916	90,182	15,207
Connecticut	14,630	58,146	11,507
Delaware	5,179	10,273	2,793
Dist. of Columbia	3,797	6,336	1,059
Florida	9,763	22,221	4,411
Georgia	22,202	48,448	10,631
Guam	96	291	160
Hawaii	2,862	8,342	1,186
Idaho	6,024	18,475	3,118
Illinois	85,236	124,217	16,340
Indiana	49,339	133,744	18,462
Iowa	42,073	97,063	17,084
Kansas	19,970	54,955	8,871
Kentucky	70,735	158,743	39,167
Louisiana	31,725	103,665	15,052
Maine	6,691	19,822	5,640
Maryland	72,323	122,068	21,602
Massachusetts	20,203	56,287	11,347
Michigan	24,538	84,829	11,941
Minnesota	21,708	79,864	13,963
Mississippi	20,951	44,780	10,445
Missouri	80,045	284,107	58,369
Montana	23,410	29,320	5,965
Nebraska	20,814	28,458	7,789
Nevada	13,654	26,443	4,850
New Hampshire	4,565	12,103	1,733
New Jersey	23,967	78,027	10,560
New Mexico	15,646	39,023	10,008
New York	33,135	83,076	29,473
North Carolina	49,826	86,427	14,948
North Dakota	8,777	13,632	2,991
Northern Marianas	0	0	0
Ohio	65,424	231,458	43,814
Oklahoma	9,197	23,127	4,309
Oregon	19,783	51,240	9,900
Pennsylvania	39,308	140,688	22,214
Puerto Rico	3,795	10,156	2,644
Rhode Island	3,601	11,637	2,027
South Carolina	17,574	61,704	12,444
South Dakota	134	252	50
Tennessee	47,364	115,776	45,083
Texas	25,293	90,367	16,743
Utah	10,949	29,420	4,216
Vermont	5,542	17,743	2,719
Virginia	32,775	72,161	13,784
Virgin Islands	0	0	0
Washington	68,644	153,456	32,767
West Virginia	9,064	15,425	5,377
Wisconsin	20,766	49,121	12,084
Wyoming	10,464	23,207	3,706
All States	1,385,131	3,468,221	688,456

Table 3-2
Violation Rates per 100 Inspections and
Ratio of Total Violations to OOS Violations

	Violation Rate	OOS Violation Rate	Ratio of Violations to OOS Violations
Alabama	277	36	7.7
Alaska	272	42	6.5
American Samoa	239	76	3.1
Arizona	414	50	8.3
Arkansas	205	52	3.9
California	151	38	4.0
Colorado	274	46	6.0
Connecticut	397	79	5.0
Delaware	198	54	3.7
Dist. of Columbia	167	28	6.0
Florida	228	45	5.1
Georgia	218	48	4.5
Guam	303	167	1.8
Hawaii	291	41	7.1
Idaho	307	52	5.9
Illinois	146	19	7.7
Indiana	271	37	7.3
Iowa	231	41	5.6
Kansas	275	44	6.3
Kentucky	224	55	4.1
Louisiana	327	47	7.0
Maine	296	84	3.5
Maryland	169	30	5.6
Massachusetts	279	56	5.0
Michigan	346	49	7.1
Minnesota	368	64	5.8
Mississippi	214	50	4.3
Missouri	355	73	4.9
Montana	125	25	5.0
Nebraska	137	37	3.7
Nevada	194	36	5.4
New Hampshire	265	38	7.0
New Jersey	326	44	7.4
New Mexico	249	64	3.9
New York	251	89	2.8
North Carolina	173	30	5.8
North Dakota	155	34	4.6
Northern Marianas	NA	NA	NA
Ohio	354	67	5.3
Oklahoma	251	47	5.3
Oregon	259	50	5.2
Pennsylvania	358	57	6.3
Puerto Rico	268	70	3.8
Rhode Island	323	56	5.8
South Carolina	351	71	4.9
South Dakota	188	37	5.1
Tennessee	244	95	2.6
Texas	357	66	5.4
Utah	269	39	6.9
Vermont	320	49	6.5
Virginia	220	42	5.2
Virgin Islands	NA	NA	NA
Washington	224	48	4.7
West Virginia	170	59	2.9
Wisconsin	237	58	4.1
Wyoming	222	35	6.3
All States	250	50	5.0

Table 3-3
Vehicle, Driver, and Hazardous Materials
Violation and OOS Violation Rates
Per 100 Inspections

	Vehicle		Driver		Hazmat	
	Violation Rate	OOS Rate	Violation Rate	OOS Rate	Violation Rate	OOS Rate
Alabama	177	23	95	11	48	11
Alaska	178	36	80	4	102	17
American Samoa	190	68	21	4	221	32
Arizona	237	32	173	17	51	12
Arkansas	128	31	57	17	24	9
California	130	32	18	5	33	6
Colorado	215	35	53	9	43	15
Connecticut	305	61	79	14	91	20
Delaware	136	38	54	13	60	17
Dist. of Columbia	126	24	35	2	91	19
Florida	174	33	43	10	50	12
Georgia	132	33	69	11	71	18
Guam	220	105	26	21	48	38
Hawaii	238	37	44	3	52	11
Idaho	173	31	116	17	119	26
Illinois	63	12	73	7	36	1
Indiana	158	30	108	7	26	4
Iowa	137	25	84	15	111	14
Kansas	169	30	102	13	26	11
Kentucky	197	45	25	10	26	15
Louisiana	223	33	95	12	47	9
Maine	255	65	34	17	39	11
Maryland	117	21	49	8	33	6
Massachusetts	161	46	108	8	224	13
Michigan	210	42	135	7	36	8
Minnesota	227	44	136	19	50	10
Mississippi	152	37	58	11	33	8
Missouri	274	58	74	13	94	23
Montana	78	16	45	9	42	7
Nebraska	76	20	57	17	28	9
Nevada	138	28	49	6	25	5
New Hampshire	139	27	121	10	15	4
New Jersey	204	33	112	8	100	21
New Mexico	188	47	56	15	48	11
New York	183	76	57	10	89	29
North Carolina	128	23	42	6	27	8
North Dakota	86	22	67	11	17	6
Northern Marianas	NA	NA	NA	NA	NA	NA
Ohio	256	46	84	17	127	36
Oklahoma	153	34	92	11	59	18
Oregon	199	40	56	10	42	6
Pennsylvania	227	43	118	12	78	14
Puerto Rico	141	59	103	2	77	26
Rhode Island	174	36	145	18	42	19
South Carolina	250	52	87	14	112	44
South Dakota	140	38	57	7	70	20
Tennessee	196	77	45	17	38	13
Texas	241	42	97	20	227	44
Utah	204	30	60	7	64	14
Vermont	179	31	132	17	123	19
Virginia	171	32	45	9	32	7
Virgin Islands	NA	NA	NA	NA	NA	NA
Washington	161	36	55	10	37	14
West Virginia	135	47	33	11	22	11
Wisconsin	180	42	53	15	45	12
Wyoming	90	18	122	15	105	28
All States	174	37	70	11	55	12

Table 3-4
Percent Full Inspections
And Mean Inspection Durations
By State

	Percent of Full Inspections	Mean Duration of Full Inspection (in minutes)
Alabama	20%	21
Alaska	68%	37
American Samoa	54%	37
Arizona	24%	35
Arkansas	45%	31
California	99%	24
Colorado	56%	23
Connecticut	39%	44
Delaware	55%	24
Dist. of Columbia	46%	21
Florida	40%	33
Georgia	37%	31
Guam	86%	22
Hawaii	87%	30
Idaho	45%	27
Illinois	13%	30
Indiana	34%	36
Iowa	30%	38
Kansas	45%	27
Kentucky	91%	33
Louisiana	65%	21
Maine	85%	24
Maryland	27%	21
Massachusetts	58%	42
Michigan	33%	36
Minnesota	34%	33
Mississippi	69%	38
Missouri	45%	36
Montana	34%	31
Nebraska	30%	22
Nevada	24%	26
New Hampshire	31%	30
New Jersey	42%	33
New Mexico	35%	31
New York	89%	27
North Carolina	26%	27
North Dakota	40%	21
No. Marianas	0%	NA
Ohio	25%	36
Oklahoma	30%	26
Oregon	60%	23
Pennsylvania	42%	44
Puerto Rico	13%	18
Rhode Island	50%	29
South Carolina	38%	38
South Dakota	29%	20
Tennessee	70%	35
Texas	27%	47
Utah	73%	34
Vermont	54%	43
Virginia	47%	30
Virgin Island	0%	NA
Washington	39%	22
West Virginia	42%	24
Wisconsin	52%	35
Wyoming	25%	31
All States	46%	31

pared to 45 percent at mobile facilities. In other words, Full Inspections predominated at fixed facilities, whereas Walk-Arounds were performed most often at mobile inspection sites.

Figures 3-3 through 3-6 compare violation rates by facility type. The overall violation rates for fixed and mobile sites were essentially identical—245 versus 246 violations, respectively, per 100 inspections (Figure 3-3). However, examination of individual vehicle, driver, and hazardous materials violation rates by facility type reveals significant differences. For instance, the vehicle violation rate was 20 percent higher at fixed, as opposed to mobile,

facilities (Figure 3-4). In contrast, the driver violation rate was 51 percent higher—and the hazardous materials violation rate was 28 percent higher—at mobile facilities than at fixed facilities (Figures 3-5 and 3-6). Of course, some of these differences can be explained by the inspection levels which predominated among the two facility types. For example, as previously observed, Full Inspections appeared to best identify *vehicle* violations, whereas Walk-Arounds and Driver-Only Inspections most aptly identified *driver* violations. It is unlikely that the differences in violation rates between the facility types, however, can be totally explained by inspection level, since inspections at both

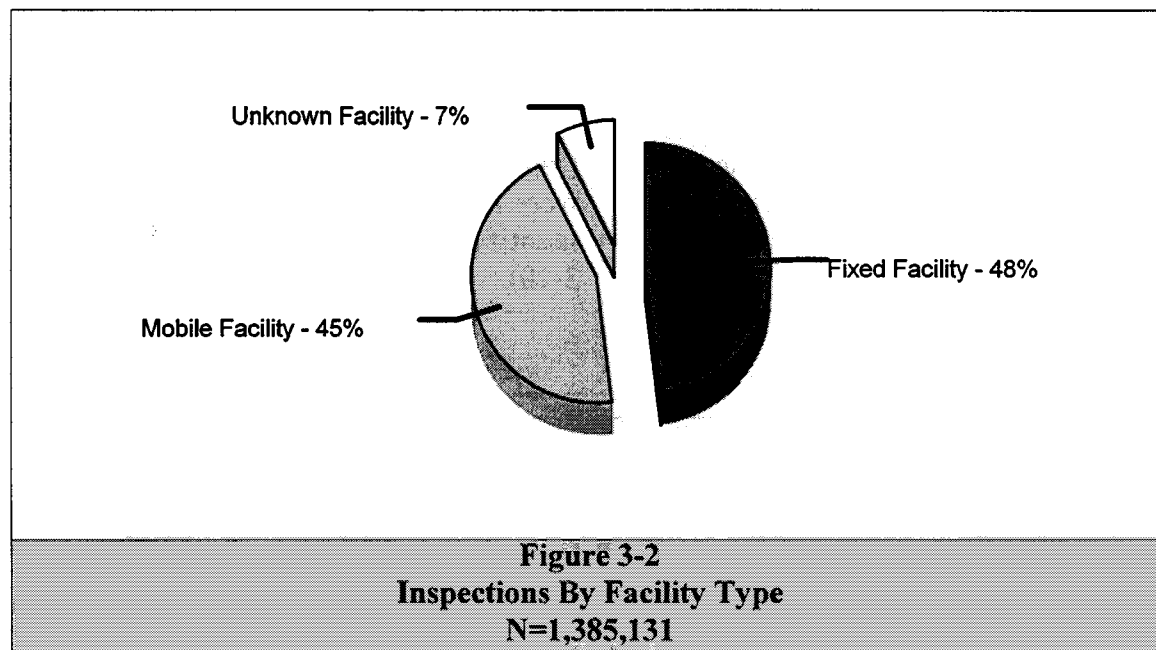


Table 3-5
Inspection and Violation Counts
By Facility Type

	Fixed		Mobile		Other/Unknown		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Inspections	665,816	48.1%	617,046	44.5%	102,269	7.4%	1,385,131	100.0%
Violations	1,632,272	47.1%	1,520,045	43.8%	315,904	9.1%	3,468,221	100.0%
OOS Violations	359,858	52.3%	273,078	39.7%	55,520	8.1%	688,456	100.0%

Table 3-6
Proportion of Inspections
By Facility Type and Inspection Level

	Fixed	Mobile	Other/ Unknown	All
Full	57.0%	34.7%	41.6%	46.0%
Walk-Around	25.0%	45.0%	42.6%	35.2%
Driver-Only	15.8%	19.3%	13.8%	17.2%
Terminal	2.0%	0.4%	1.3%	1.2%
Special	0.2%	0.6%	0.7%	0.4%
Total Inspections	665,816	617,046	102,269	1,385,131

types of facilities involved a mix of inspection levels. After all, while the proportion of Driver-Only Inspections was 22 percent higher at mobile facilities than at fixed facilities, the driver violation rate was 51 percent higher at mobile facilities.

Interestingly, the OOS violation rates by facility type tended not to mirror violation rates generally. For instance, Figure 3-5 shows that although the driver violation rate at mobile facilities was markedly higher than at fixed facilities (83 versus 55 violations per 100 inspections), the OOS rate for drivers was, in fact, highest at fixed facilities (12

versus 10). Overall, the ratio of violations-to-OOS violations was lowest at fixed facilities (Figure 3-7).

Figures 3-8 through 3-10 examine selected defects by facility type. Whereas brake violations were most likely to be identified, as expected, at fixed facilities, the identification of lighting violations tended to predominate at mobile facilities (Figure 3-8). Note that mobile facilities were more likely than fixed facilities to identify shipping paper violations (Figure 3-10).

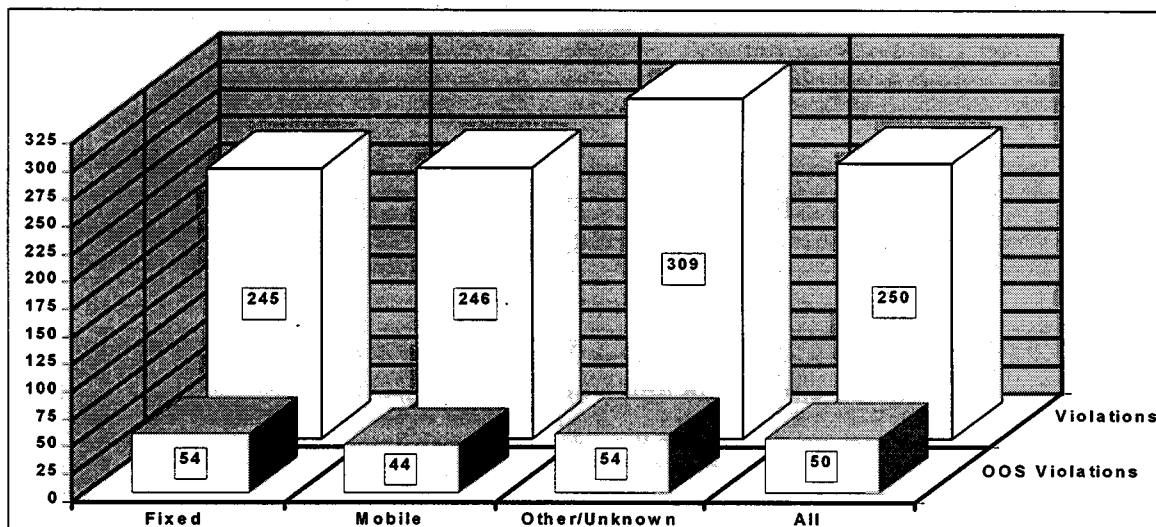


Figure 3-3
Violation and OOS Violation Rates
Per 100 Inspections by Facility Type

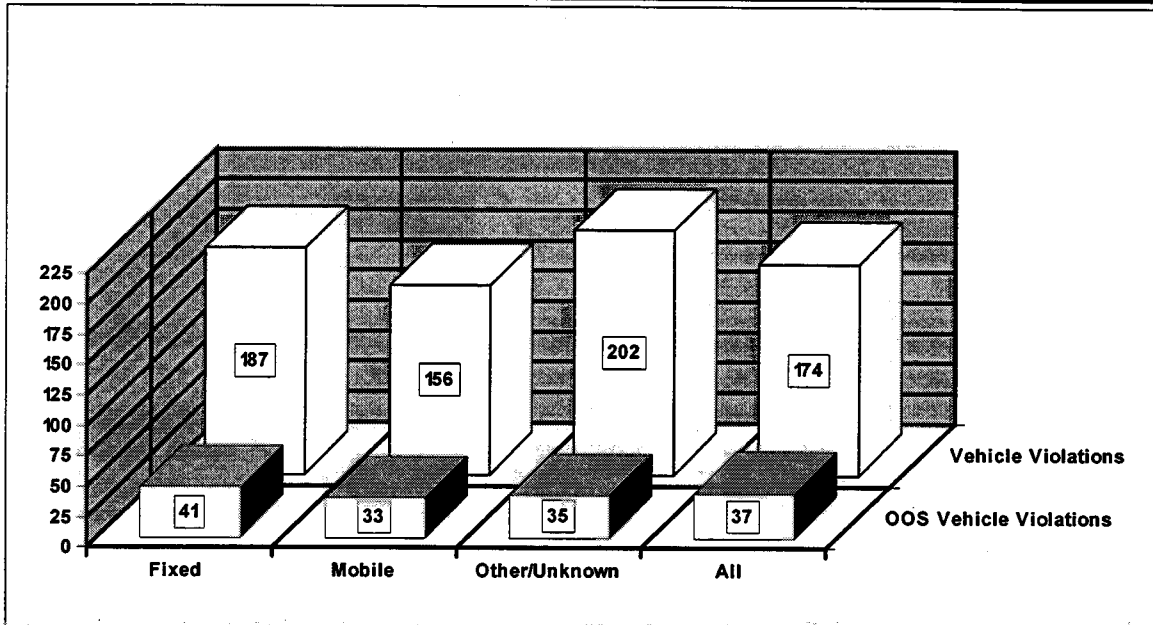


Figure 3-4
Vehicle Violation and OOS Violation Rates
Per 100 Inspections by Facility Type
N=1,385,131

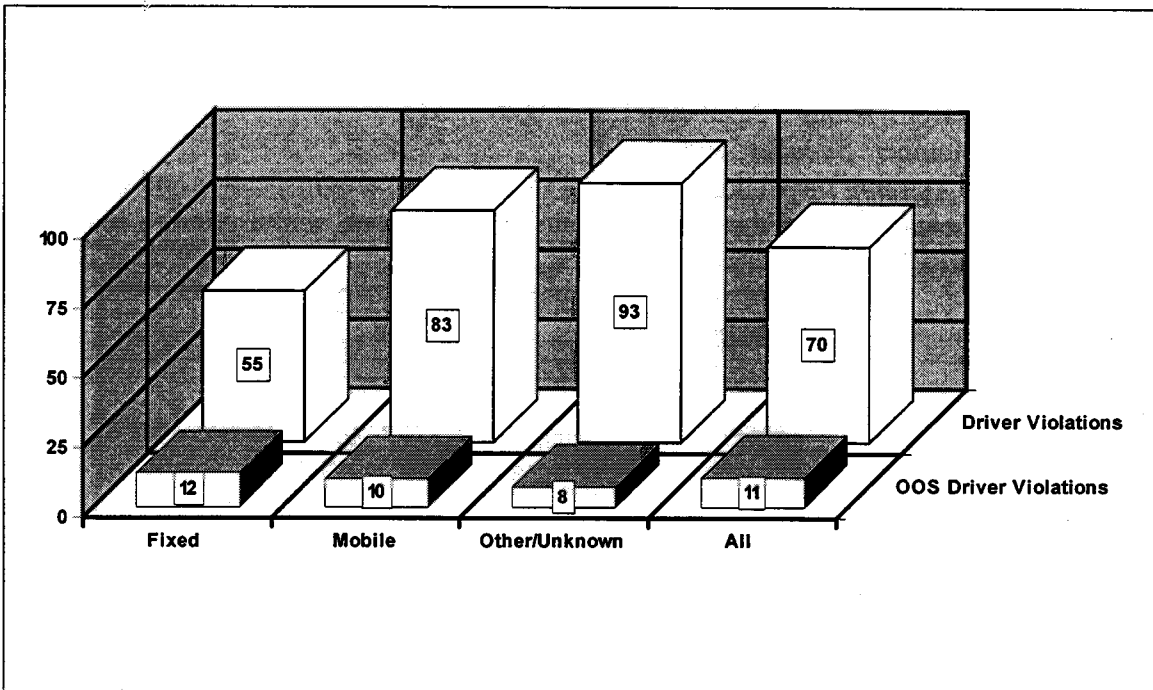


Figure 3-5
Driver Violation and OOS Violation Rates
Per 100 Inspections by Facility Type
N=1,385,131

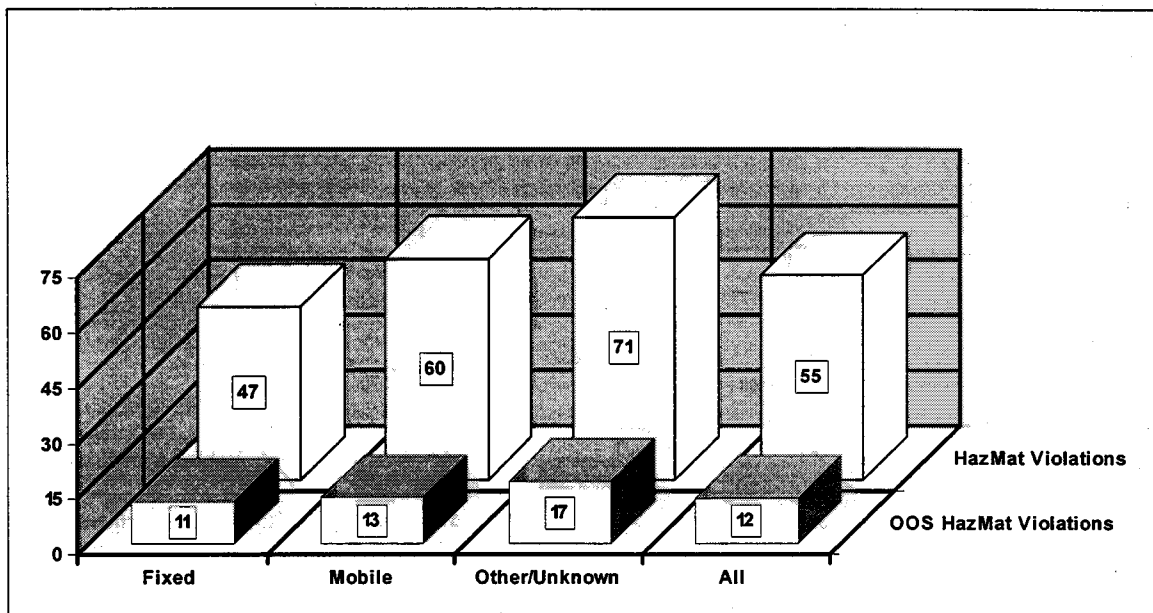


Figure 3-6
Hazardous Materials Violation and OOS Violation Rates
Per 100 Hazardous Materials Inspections by Facility Type
N=134,603

SEASON

To examine inspection activity by seasons, inspection "months" were grouped as follows: January-March: *Winter*; April-June: *Spring*; July-September: *Summer*; and October-December: *Autumn*. Inspection activity was fairly constant during the Spring,

Summer, and Autumn, but dropped off somewhat in the Winter—nearly 4 out of 5 inspections performed in 1994 occurred during the Spring, Summer, and Autumn (Figure 3-11).

Table 3-7 compares inspection and violation activity by season, and Table 3-8 displays

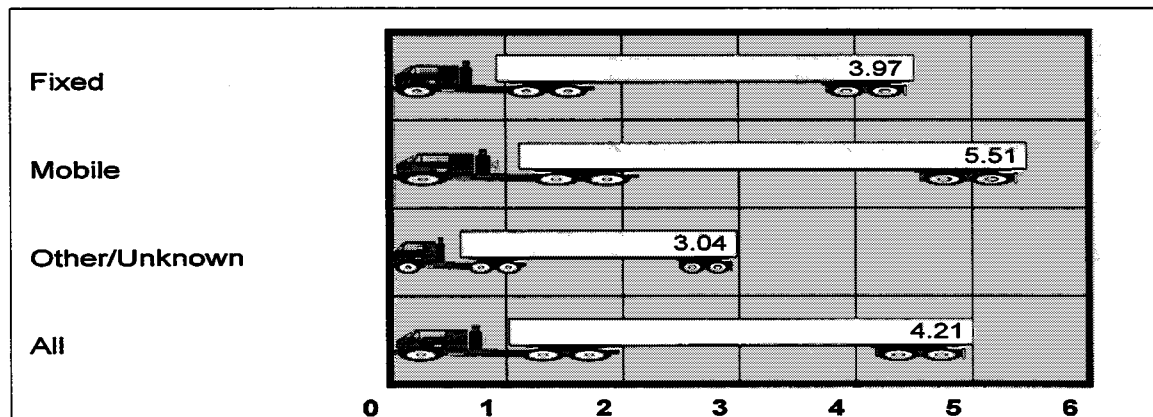


Figure 3-7
Ratio of Total Violations
To Out-of-Service Violations by Facility Type
N=1,385,131

seasonal activity by inspection level. As shown in the latter table, proportionally more Full Inspections were conducted in Summer, whereas Walk-Arounds were performed with greater frequency in Winter.

Though the differences were not dramatic, violation rates did appear to vary by season (Figures 3-12 through 3-15). Aggregate violation rates were highest in the Summer (261 per 100 inspections) and lowest in the Win-

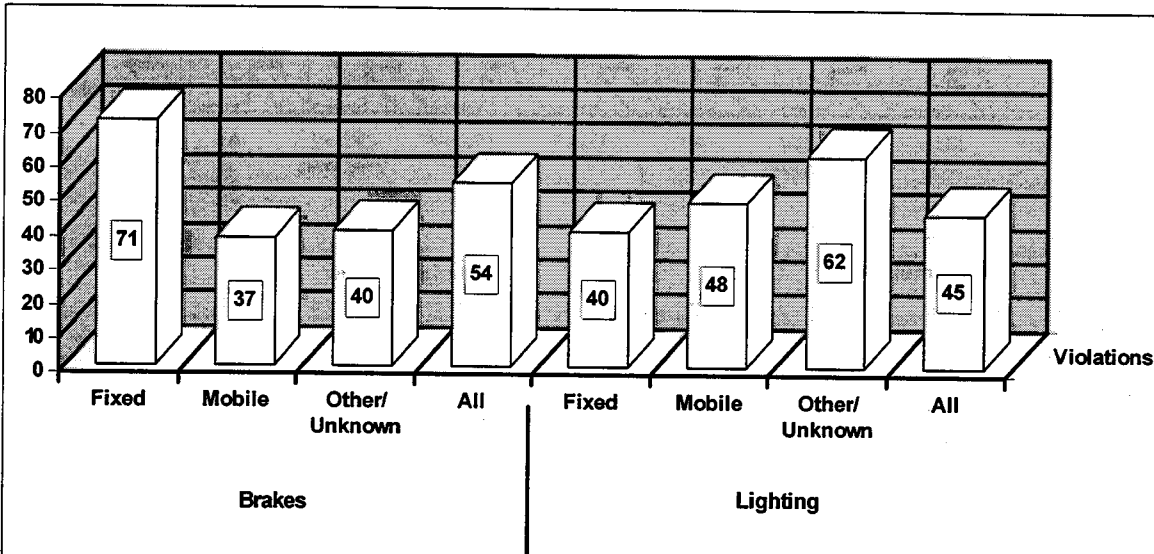


Figure 3-8
Brake/Lighting Defects By Facility Type
Violation Rates per 100 Inspections

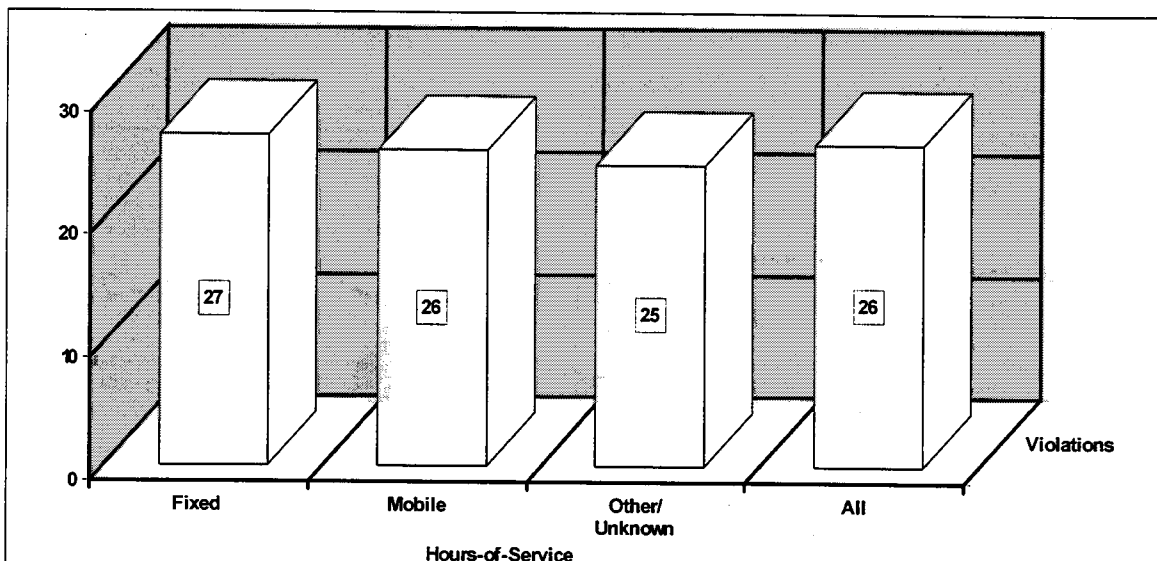


Figure 3-9
Hours-of-Service Defects
By Facility Type
Violation Rates per 100 Inspections

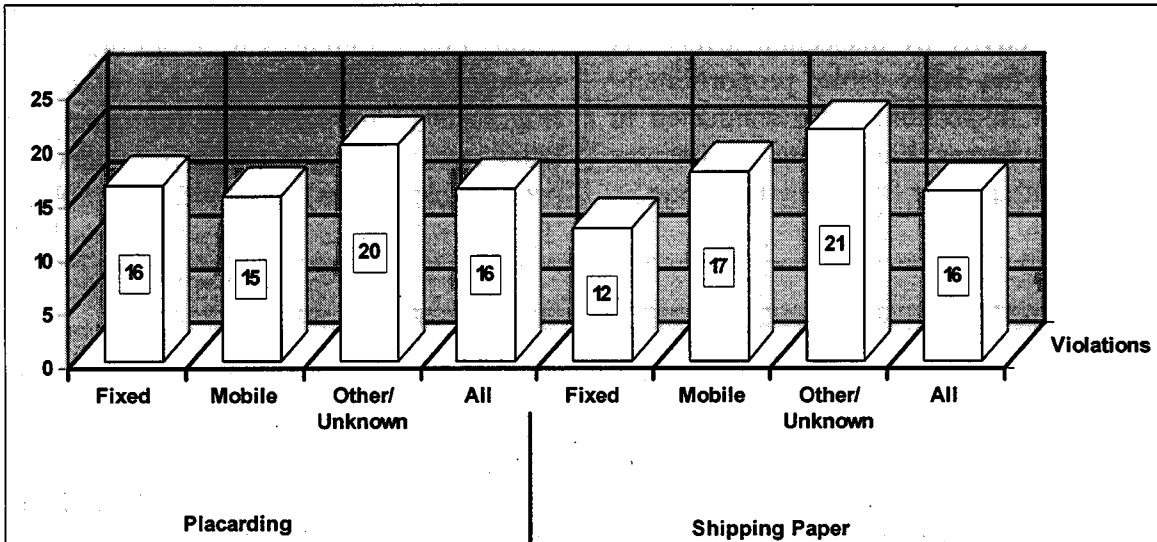


Figure 3-10
Placarding/Shipping Paper Defects
By Facility Type
Violation Rates Per 100 HazMat Inspections

ter (230); the rates were nearly identical in the Spring and Autumn (254 and 253, respectively). OOS violation rates were highest in the Spring (52) and lowest in Winter (45). Vehicle violation rates ranged from 154 in Winter to 182 in Summer (Figure 3-13), but driver violation rates were nearly

identical in Winter (70) and Summer (71) (Figure 3-14); the hazardous materials violation rate was slightly lower in Winter (51) than in Summer (58) (Figure 3-15). These results may be explained, in part, by the fact that a higher proportion of Full inspections were performed in Summer than in Winter,

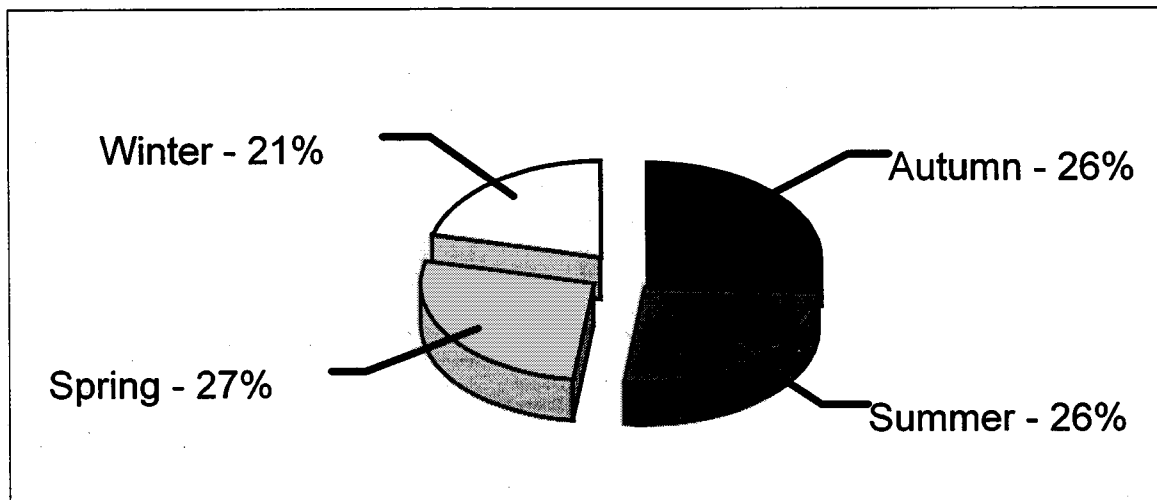


Figure 3-11
Inspections By Season

Table 3-7
Inspection and Violation Counts
By Season

	Winter		Spring		Summer		Autumn		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Inspections	298,519	21.6%	371,377	26.8%	357,448	25.8%	357,787	25.8%	1,385,131	100.0%
Violations	686,696	19.8%	943,018	27.2%	933,249	26.9%	905,258	26.1%	3,468,221	100.0%
OOS Violations	135,100	19.6%	194,578	28.3%	182,817	26.6%	175,961	25.6%	688,456	100.0%

whereas the proportion of Walk-Arounds and Driver-Only Inspections was highest in Winter (Table 3-8).

Figure 3-16 depicts the ratio of violations to out-of-service violations by season. The ratio was most favorable in Spring, when one OOS violation occurred for every 4.85 violations. Surprisingly, the ratio was slightly better in Winter (5.08) than in Summer (5.11) and Autumn (5.15).

Figures 3-17 through 3-19 chronicle selected defect activities by season.

TIME-OF-DAY

Fifty percent of all interstate inspections performed in 1994 occurred within a six-hour period: 6AM-12 Noon, and 80 percent happened within a 12-hour period: 6AM-6PM (Figure 3-20). A complete breakout of inspection activity and inspection levels by

time-of-day is presented in Tables 3-9 and 3-10.

Figures 3-21 through 3-27 suggest that there were meaningful differences in inspection outcomes according to *time-of-day* of the inspections. In general, daytime inspections produced higher violation and OOS violation rates than did nighttime inspections. For instance, for every 100 inspections conducted between 6AM-12 Noon and 12 Noon-6PM, there were 263 and 247 violations, respectively (Figure 3-21). This compares with rates of 223 and 219 for inspections conducted between 12 Midnight-6AM and 6PM-12 Midnight, respectively. In other words, the violation rate was approximately 17 percent higher for inspections which occurred during daytime hours (6AM-6PM) than nighttime hours (6PM-6AM).

These differences are even more pro-

Table 3-8
Proportion of Inspections
By Season and Inspection Level

	Winter	Spring	Summer	Autumn	All
Full	39.1%	46.4%	50.1%	47.1%	46.0%
Walk-Around	39.3%	35.2%	33.0%	34.2%	35.2%
Driver-Only	20.0%	16.6%	15.2%	17.4%	17.2%
Terminal	0.3%	0.3%	0.6%	0.3%	0.4%
Special	1.3%	1.5%	1.2%	1.0%	1.2%
Total	298,519	371,377	357,448	357,787	1,385,131

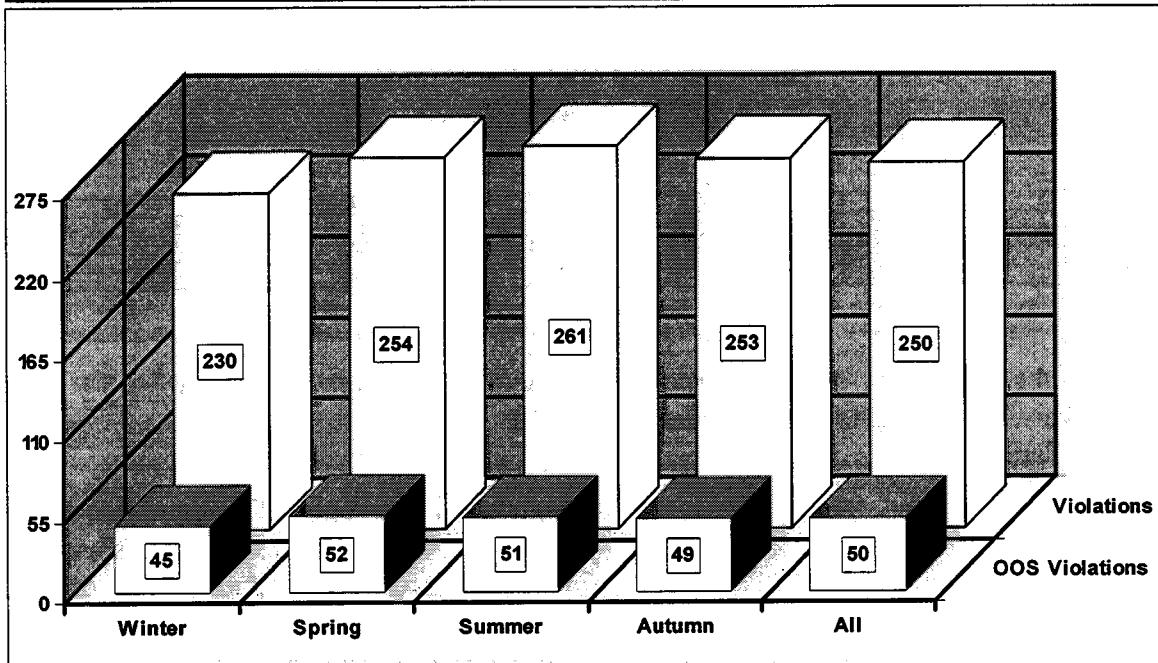


Figure 3-12
Violation and OOS Violation Rates
Per 100 Inspections by Season
N=1,385,131

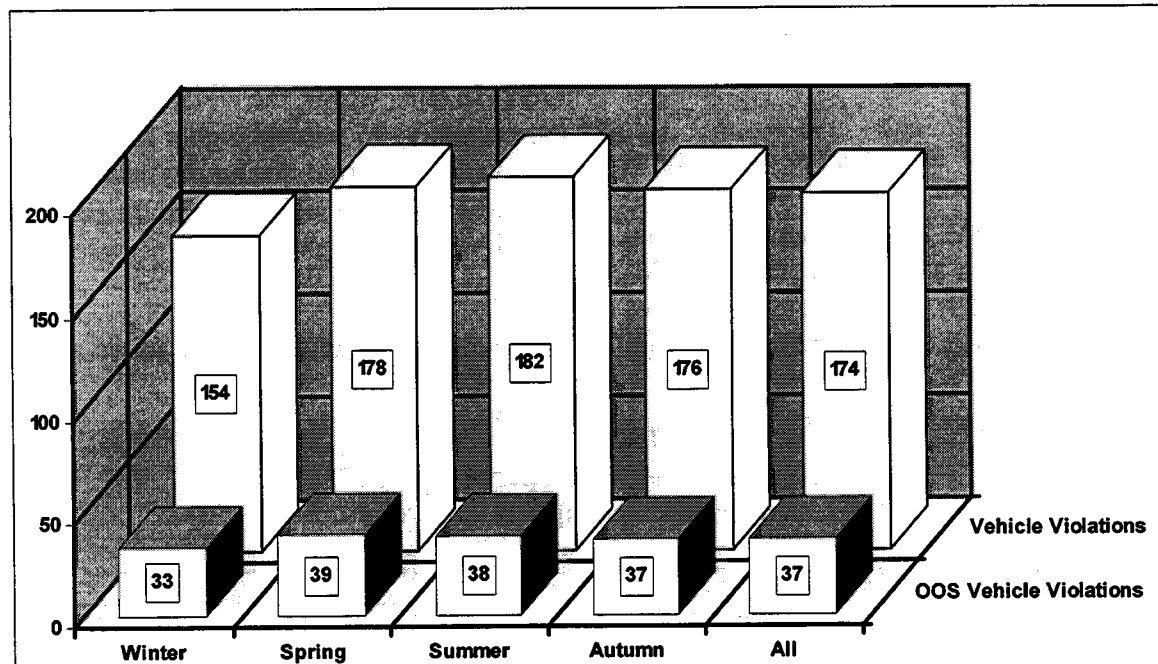


Figure 3-13
Vehicle Violation and OOS Violation Rates
Per 100 Inspections by Season
N=1,385,131

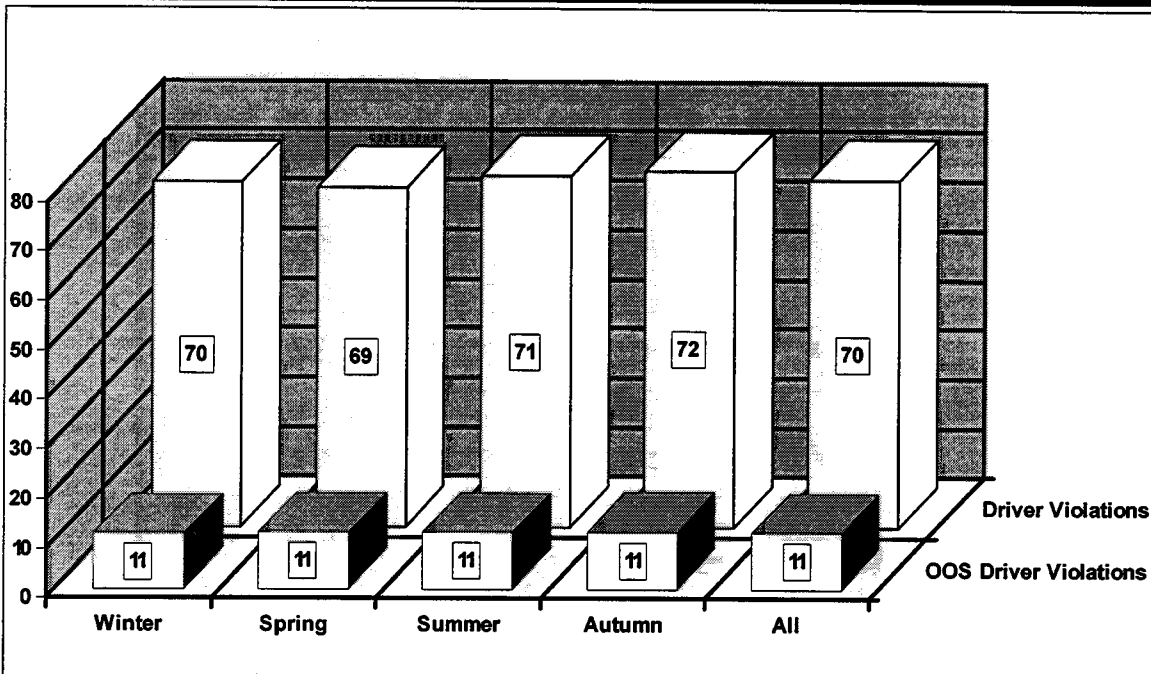


Figure 3-14
Driver Violation and OOS Violation Rates
Per 100 Inspections by Season
N=1,385,131

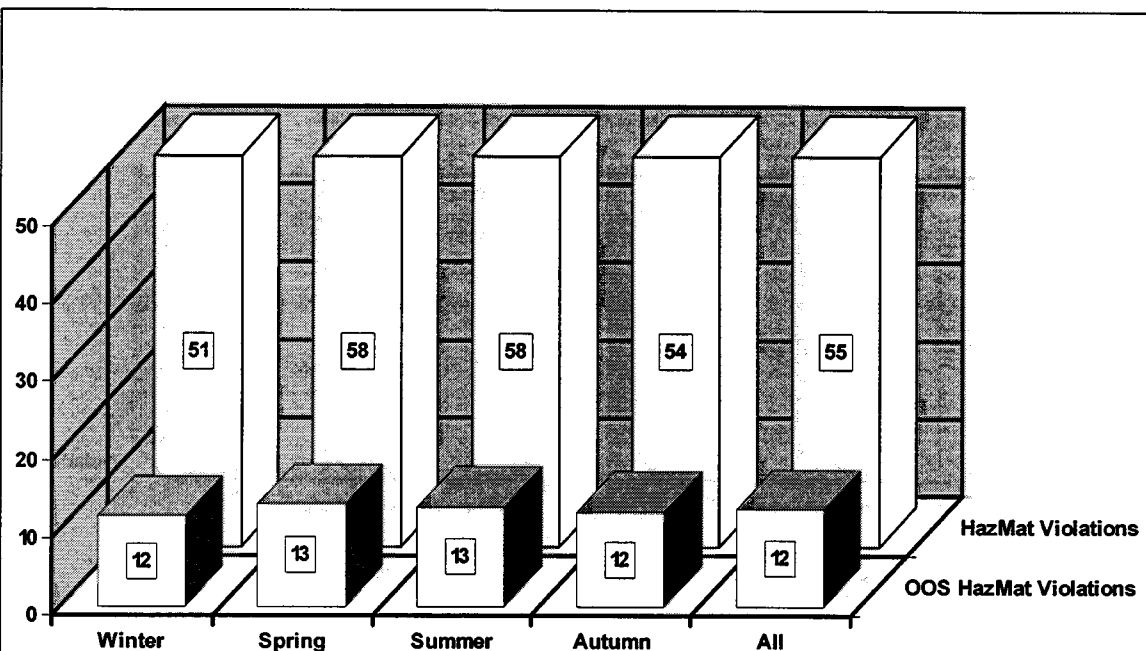
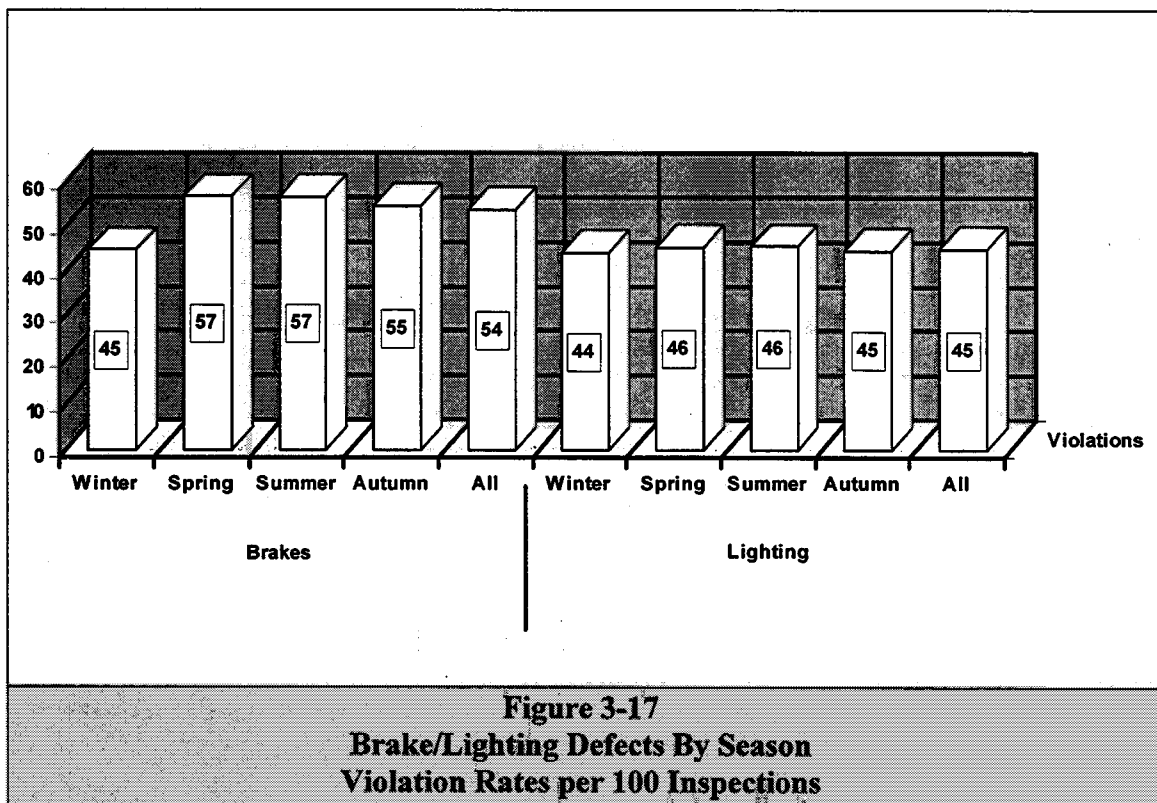
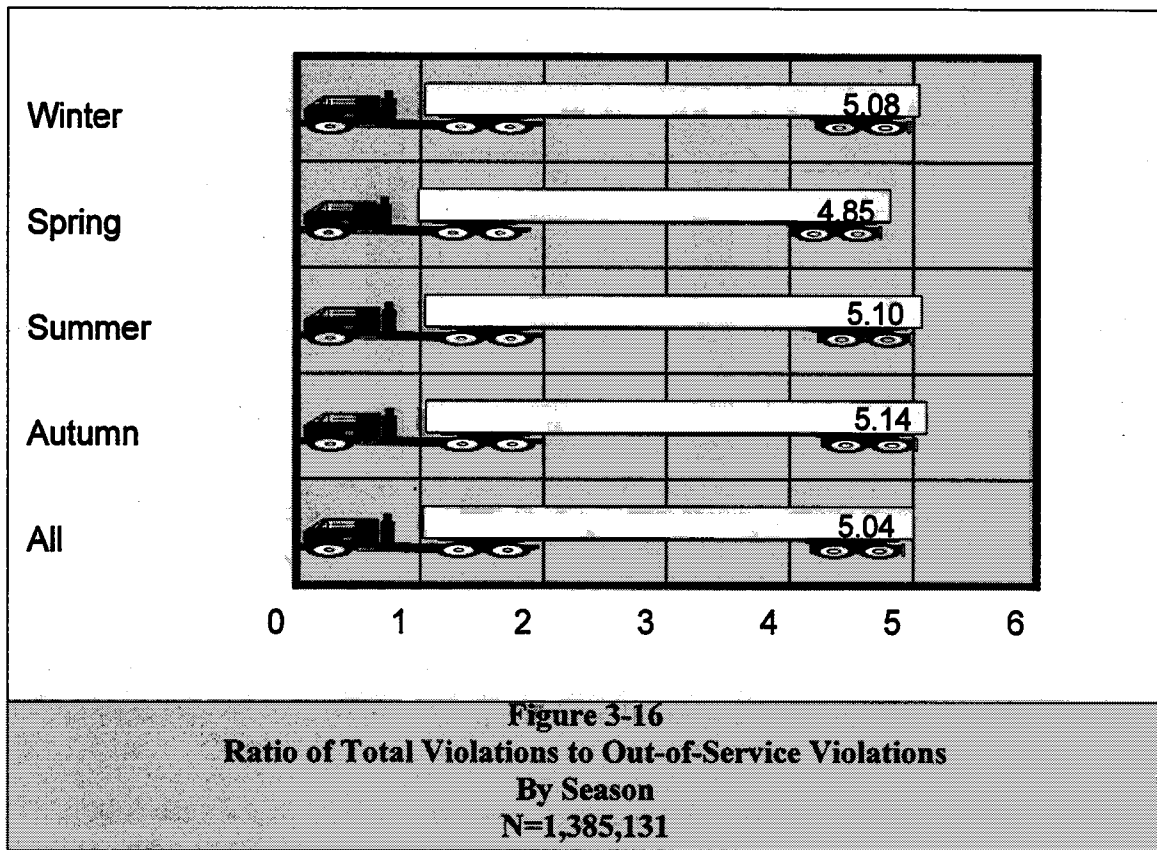


Figure 3-15
Hazardous Material Violation and OOS Violation Rates
Per 100 Hazardous Materials Inspections by Season
N=134,603



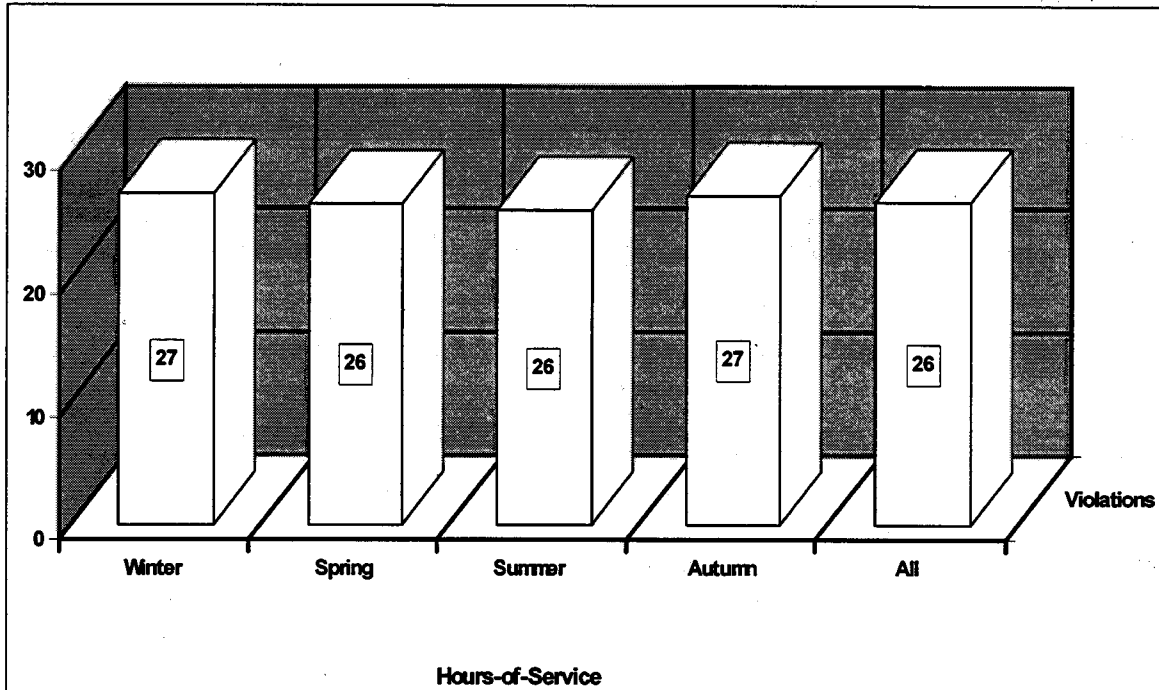


Figure 3-18
Hours-of-Service Defects By Season
Violation Rates per 100 Inspections

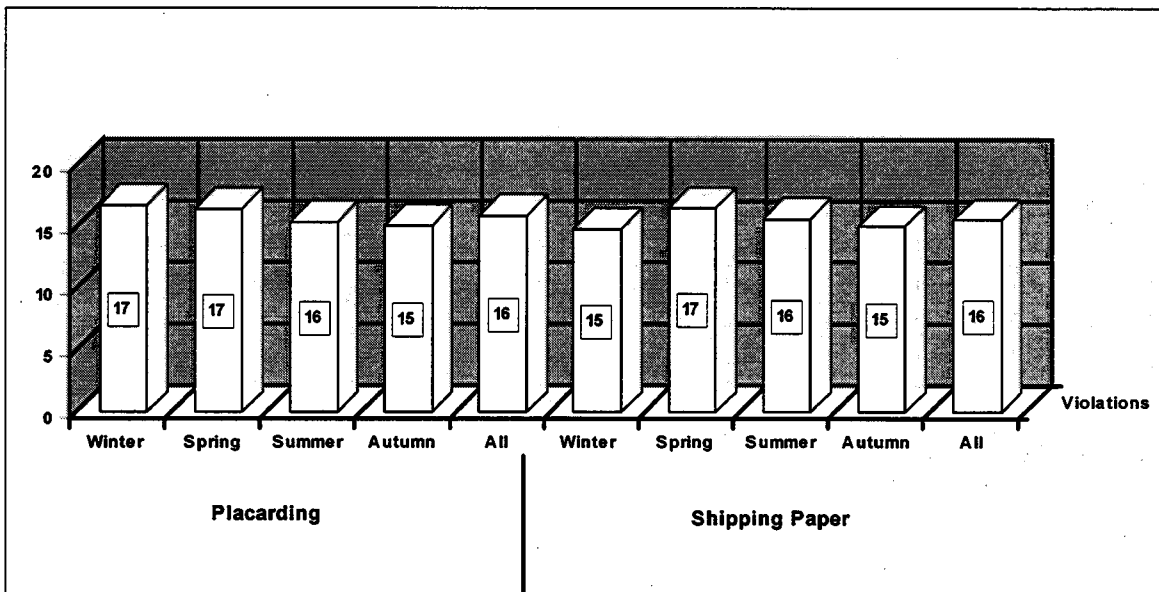


Figure 3-19
Placarding/Shipping Paper Defects By Season
Violation Rates per 100 HazMat Inspections

nounced when vehicle and hazardous materials violation rates are examined separately (Figures 3-22 and 3-24). Vehicle violation rates were 32 percent higher for daytime versus nighttime inspections, and hazardous materials violation rates were 30 percent higher. The sole exception pertained to

driver violation rates, which were 15 percent lower during the day (Figure 3-23). The ratio of violations to out-of-service violations was lower at night (1:4.8) than during the day (1:5.1), meaning that nighttime inspections were somewhat more likely to identify violations which resulted in out-of-

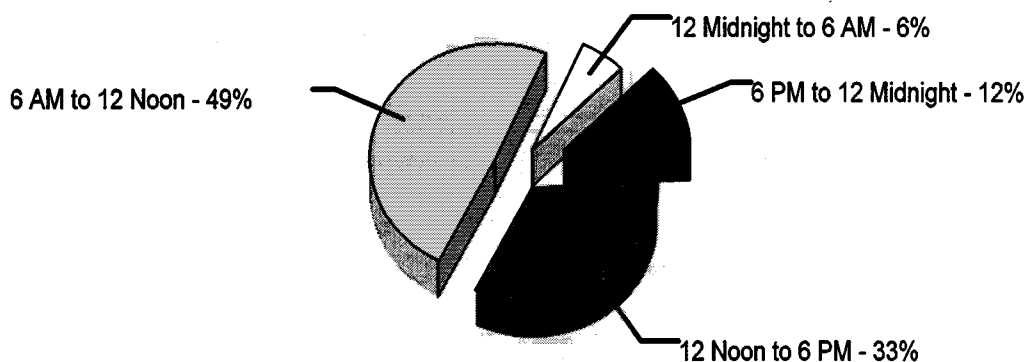


Figure 3-20
Inspections By Time-of-Day
N=1,385,131

Table 3-9
Inspection and Violation Counts
By Time-of-Day

	12 Midnight to 6 AM		6 AM to 12 Noon		12 Noon to 6 PM		6 PM to 12 Midnight		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Inspections	80,719	5.8%	682,144	49.2%	459,633	33.2%	162,635	11.7%	1,385,131	100.0%
Violations	179,675	5.2%	1,794,861	51.8%	1,136,797	32.8%	356,888	10.3%	3,468,221	100.0%
OOS Violations	38,872	5.6%	352,097	51.1%	223,970	32.5%	73,517	10.7%	688,456	100.0%

Table 3-10
Proportion of Inspections
By Time-of-Day and Inspection Level

	12 Midnight to 6 AM	6 AM to 12 Noon	12 Noon to 6 PM	6 PM to 12 Midnight	All
Full	36.8%	49.3%	46.3%	35.5%	46.0%
Walk-Around	37.3%	34.5%	35.1%	37.6%	35.2%
Driver-Only	25.1%	14.3%	16.9%	25.9%	17.2%
Terminal	0.1%	1.5%	1.2%	0.5%	1.2%
Special	0.6%	0.3%	0.4%	0.5%	0.4%
Total	80,719	682,144	459,633	162,635	1,385,131

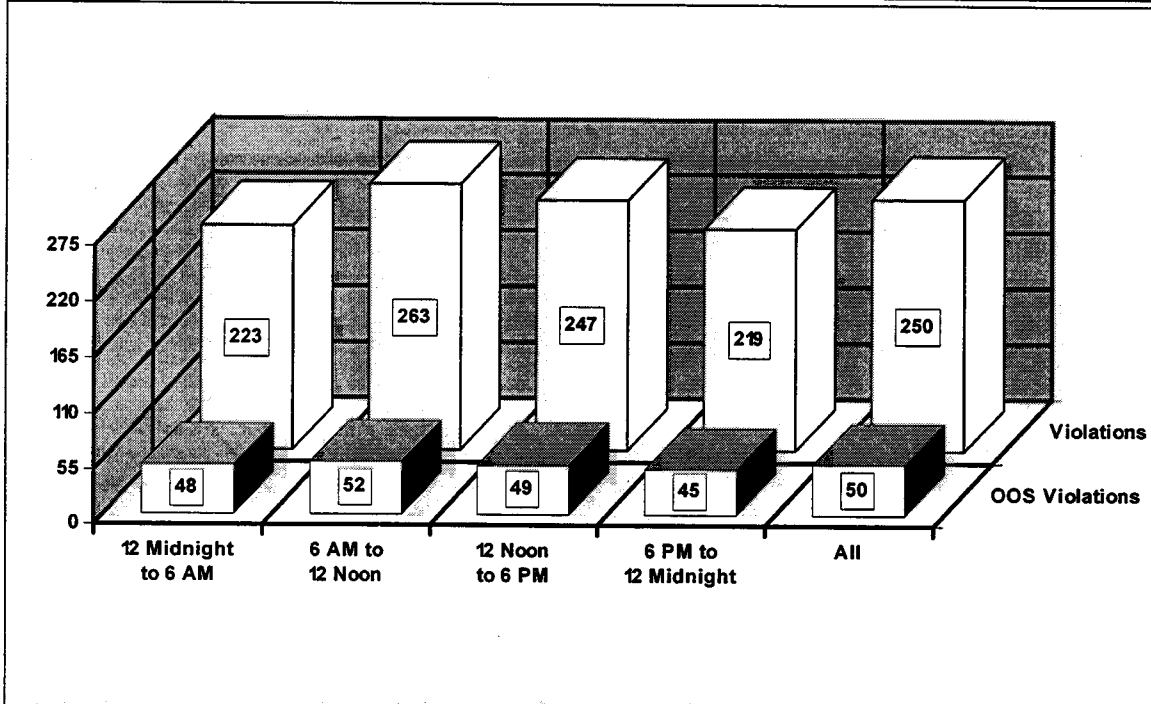


Figure 3-21
Violation and OOS Violation Rates
Per 100 Inspections by Time-of-Day
N=1,385,131

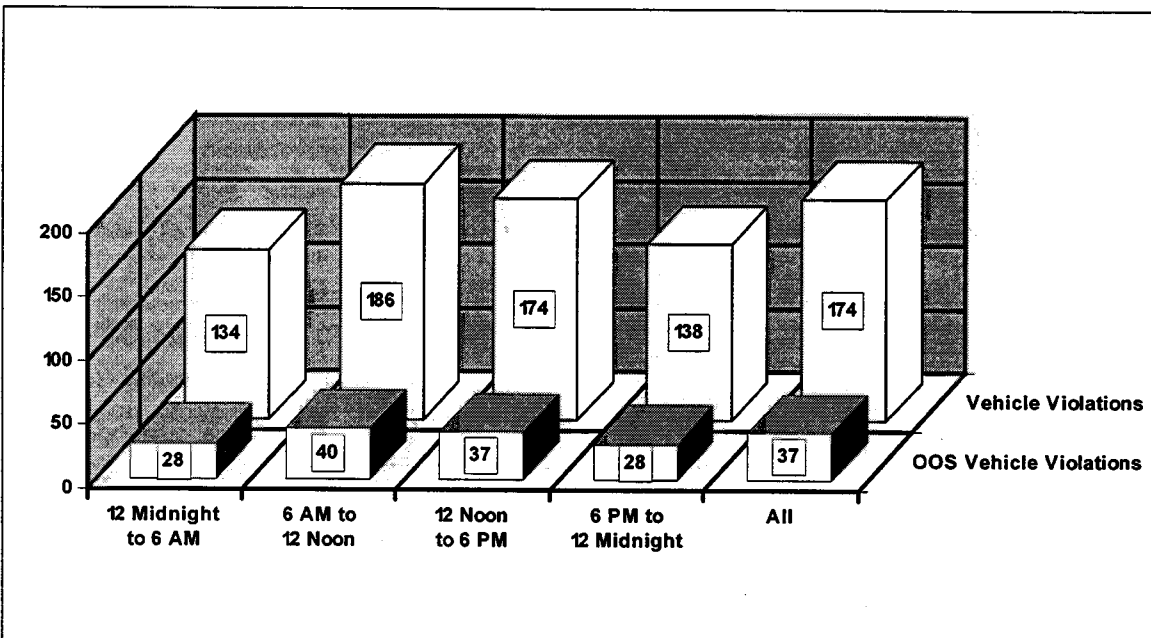


Figure 3-22
Vehicle Violation and OOS Violation Rates
Per 100 Inspections by Time-of-Day
N=1,385,131

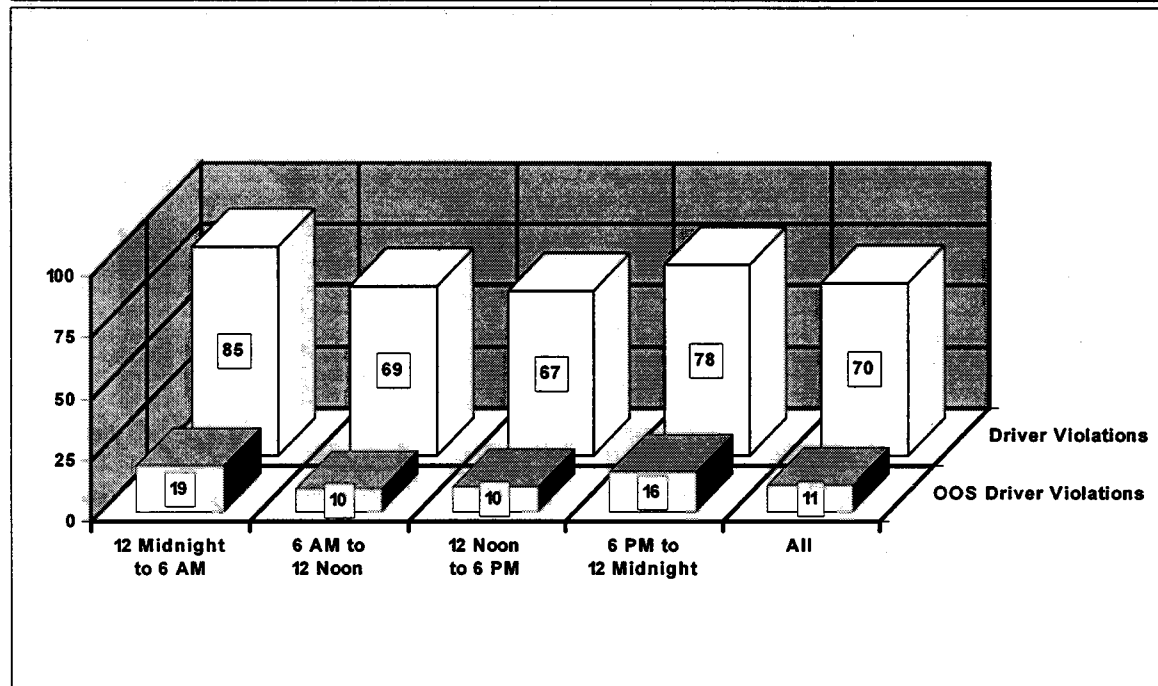


Figure 3-23
Driver Violation and OOS Violation Rates
Per 100 Inspections by Time-of-Day
N=1,385,131

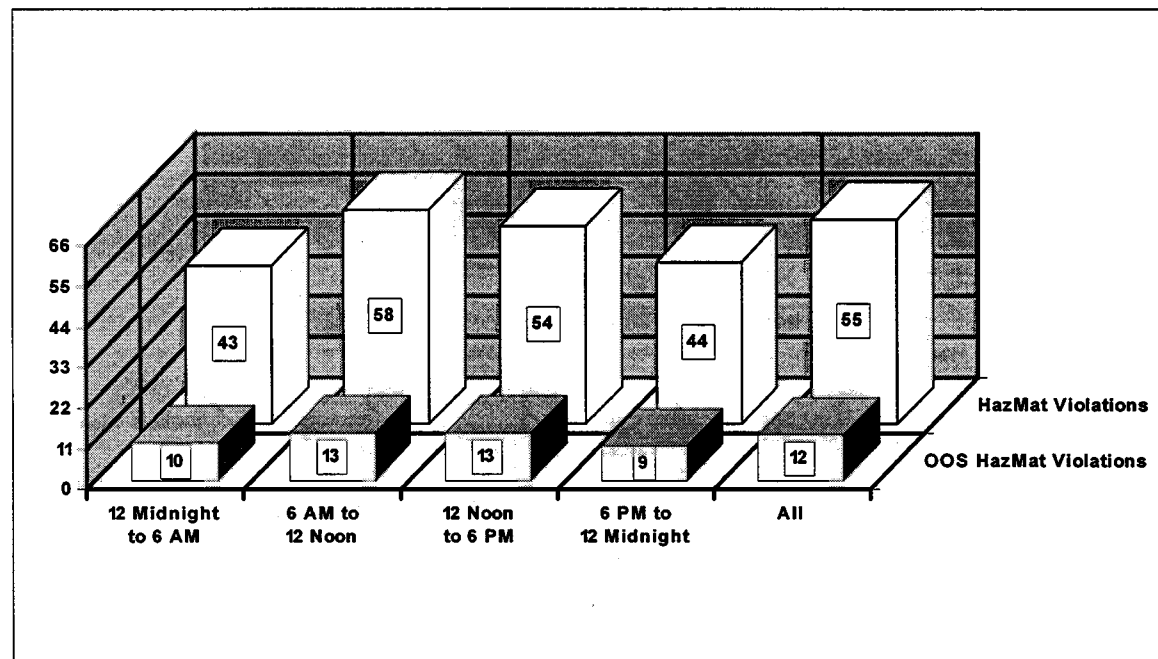


Figure 3-24
Hazardous Materials Violation and OOS Violation Rates
Per 100 Hazardous Materials Inspections by Time-of-Day
N=134,603

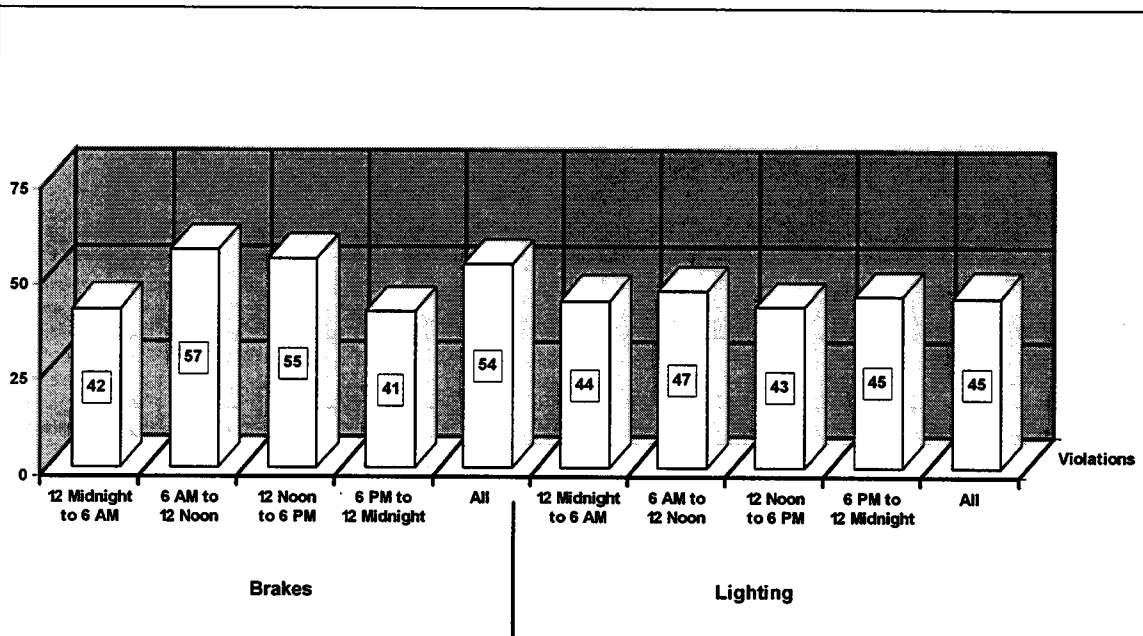


Figure 3-25
Brake/Lighting Defects By Time-of-Day
Violation Rates per 100 Inspections

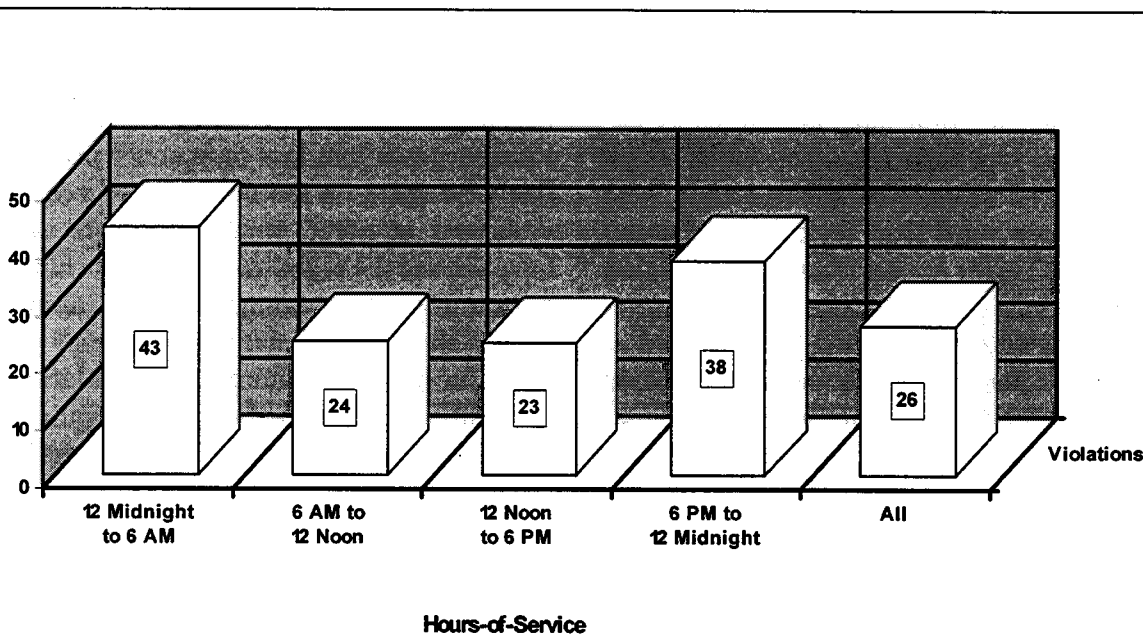
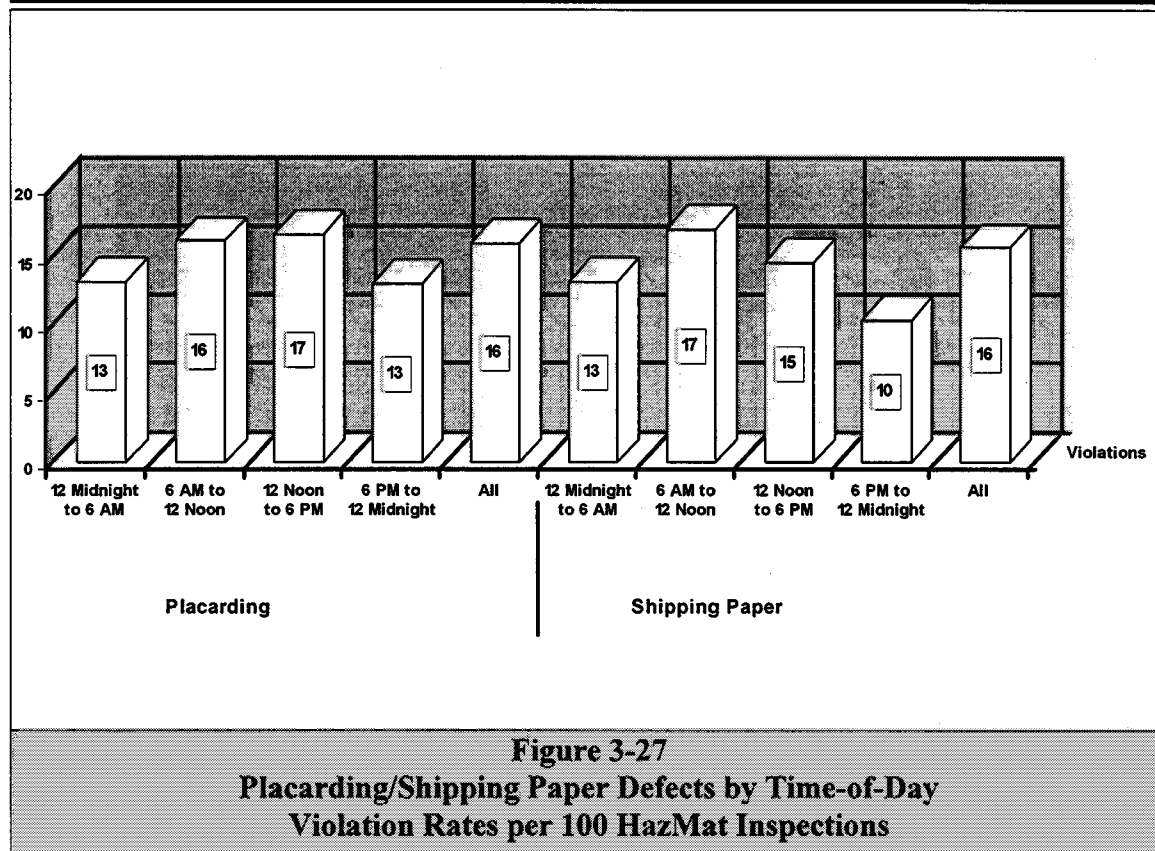


Figure 3-26
Hours-of-Service Defects By Time-of-Day
Violation Rates per 100 Inspections



service citations than daytime inspections.

Some of the differences in daytime versus nighttime violation rates are, perhaps, explainable. One theoretical possibility is that commercial vehicles traveling at night were better maintained than their daytime counterparts. This is not a particularly satisfying explanation, given that many interstate vehicles moved both during the day and at night; furthermore, the boundaries between daytime and nighttime travel were not rigid—long-haul trips beginning during the night were often likely to end after daybreak, and vice-versa. A better explanation might be that some defects—especially defects pertaining to the vehicle—were difficult to detect during the night. For instance, the daytime rate of brake violations was 56, as opposed to a rate of 41 for the nighttime. On the other hand, the rate of lighting defects

was identical—averaging 45 both during the day and at night. This should not be surprising, since most lighting defects should have been equally detectable during day or night. Finally, given that less time could productively be spent on the detection of vehicle violations at night, some inspectors may have viewed the nighttime as an opportunity to examine more thoroughly driver compliance with safety regulations. This may explain, in part, why more driver violations generally were detected at night (Figure 3-23); significantly, the rate of hours of service violations was 70 percent higher at night than during the day.

DURATION

The mean duration of interstate inspections performed in 1994 was 31 minutes. Sixty-nine percent of the inspections conducted

during the year were completed in 30 minutes or less, while 31 percent lasted 30-60 minutes; only 5 percent of the inspections had durations in excess of 60 minutes (Figure 3-28). A breakout of inspections and violations by duration is presented in Table 3-11. Figure 3-29 specifies the mean duration of inspections by level. Fifty-two percent more time was required to complete a Full Inspection (35 minutes) than a Driver-Only Inspection (23 minutes); Walk-Arounds were midway between the two extremes at 30 minutes. As indicated in Figure 3-30, vehicle configuration had a relatively weak impact on inspection duration. While 51 percent of all inspections had durations of 15-30 minutes, 53 percent of straight trucks, 51 percent of singles, 49 percent of doubles, and 57 percent of triples fell within this range. At the upper-end of the continuum of inspection durations, vehicle configuration had a slightly stronger—though far from overwhelming—impact. Only 3 percent of all inspections involving straight trucks lasted more than 60 minutes; this compared with 5 percent of singles, 7 percent of doubles, and 8 percent of triples.

Also, there were not marked differences in duration between inspections involving hazardous and non-hazardous materials. Indeed, inspections of vehicles transporting hazardous materials had, on average, a shorter duration (31 minutes) than did inspections involving non-hazardous materials (32 minutes). This finding may be explained, in part, by observations discussed in Chapter 2—i.e., that vehicles and drivers transporting hazardous materials tended to have fewer defects than did their non-hazardous counterparts.

Figures 3-31 through 3-34 suggest the existence of a strong correlation between inspection duration and inspection outcomes.

Inspections completed in 15 minutes or less averaged 113 violations per 100 inspections (Figure 3-31); this rate increased by 80 percent, to 203 violations, when average duration was extended by 15 minutes. In fact, the violation rate increased by 419 percent, to 586 violations per 100 inspections, as average duration expanded from 15 minutes or less to 60 minutes or more. Of course, what is not clear from the data is whether the mere performance of longer inspections yielded more violations, or whether protracted inspections were, instead, performed precisely *because* they involved those vehicles and drivers which had more violations in the first place. To put it another way: Would a 15-minute inspection have resulted in the detection of substantive additional violations if more time had been expended on the inspection?

In addition to there being a strong correlation between inspection durations and inspection outcomes, the severity of violations, themselves, appeared to increase as inspection length increased. As shown in Figure 3-35, the ratio of total violations-to-OOS violations declined from 7.6, for inspections of less than 15 minutes duration, to 3.5, for inspections which were more than 60 minutes in length.

The results are even more striking when individual defects are examined (Figures 3-36 through 3-38). For instance, brake violations were detected at a rate of 11, 42, and 142 violations (per 100 inspections) for durations of 0-15 minutes, 15-30 minutes, and over 60 minutes, respectively (Figure 3-36). What is not shown is that the corresponding OOS violation rates for brakes were 3, 11, and 57, respectively; the violation ratios were 4.4, 3.7, and 2.5, respectively. Thus, not only did the raw number of violations increase dramatically with longer inspec-

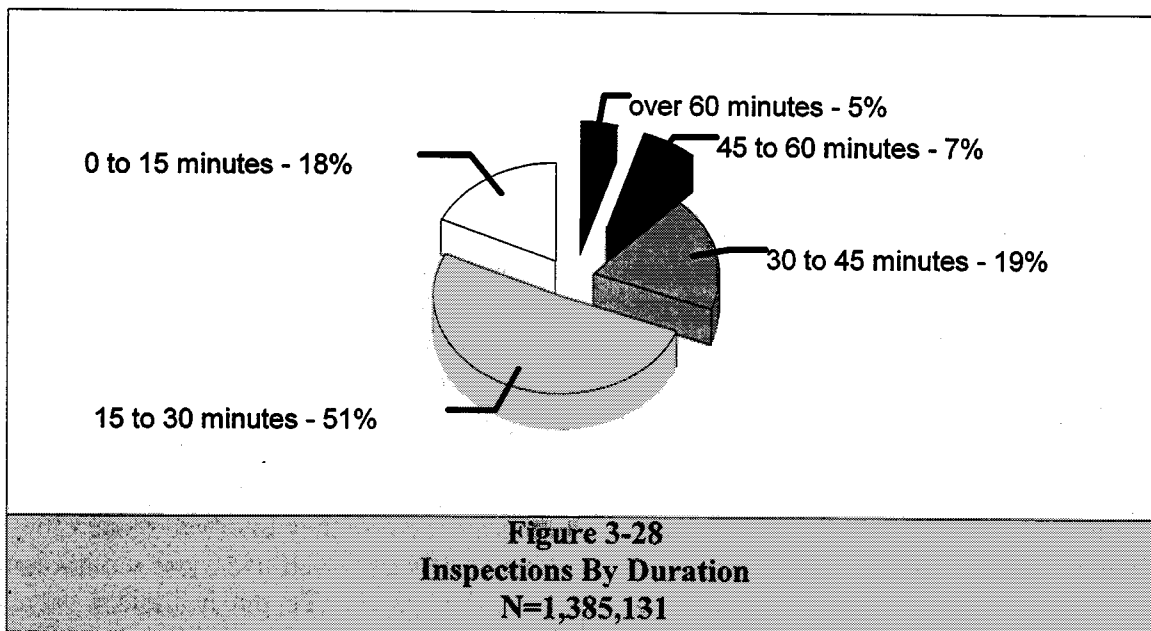


Table 3-11
Inspection and Violation Counts
By Inspection Duration

	0 to 15 minutes		15 to 30 minutes		30 to 45 minutes		45 to 60 minutes		Over 60 minutes		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Inspections	248,543	17.9%	709,467	51.2%	261,349	18.9%	99,254	7.2%	66,518	4.8%	1,385,131	100.0%
Violations	281,217	8.1%	1,438,423	41.5%	884,756	25.5%	473,798	13.8%	390,027	9.5%	3,468,221	100.0%
OOS Violations	37,239	5.4%	248,317	36.1%	179,974	26.1%	112,019	16.2%	110,907	13.3%	688,456	100.0%

tions, but the proportion of violations designated out-of-service also rose significantly.

We return, finally, to an issue first raised early in this report—namely, the identification of the *optimal* inspection methodology. The optimal methodology is defined here as that inspection technique which yields the highest violation and OOS violation rates across a common timeframe.

In Table 3-12, the national averages for inspection duration are used to calculate mean violation and OOS violation rates per *inspection-hour*. For example, since the av-

erage Driver-Only Inspection was 23 minutes in length, one could expect to perform 2.63 inspections over a period of 60 minutes; because the average Driver-Only Inspection resulted in 0.96 violations per inspection, one would then expect to detect 2.52 violations over a period of 60 minutes ($2.63 * 0.96$). In other words, in 1994, Driver-Only Inspections yielded an average of 2.52 violations and 0.42 OOS violations per inspection-hour. This compared with 4.81 violations and 0.75 OOS violations for Walk-Arounds—and 5.59 violations and 1.25 OOS violations for Full Inspections—per inspection-hour.

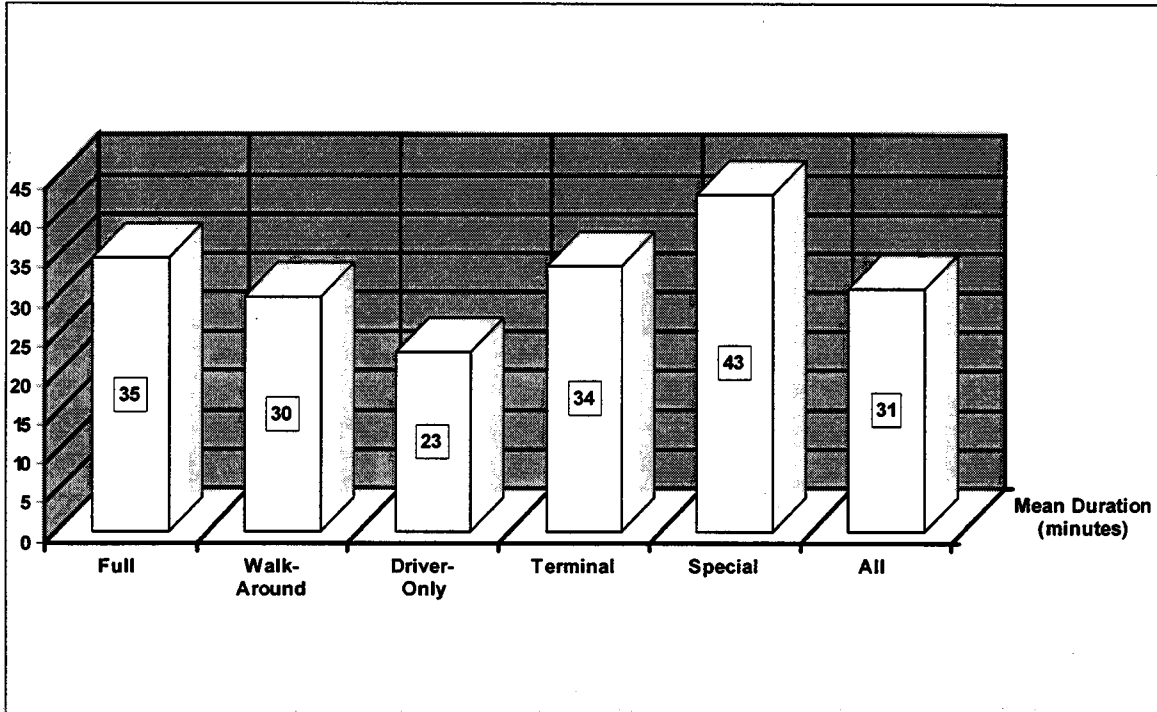


Figure 3-29
Inspections by Level and Mean Duration

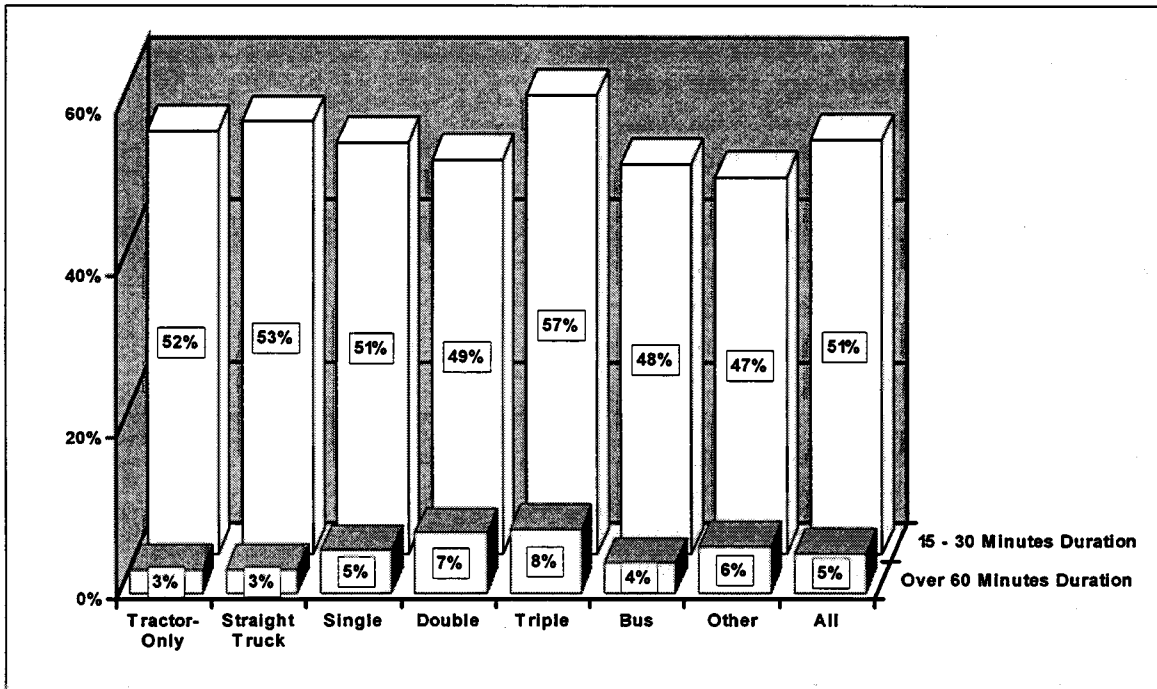
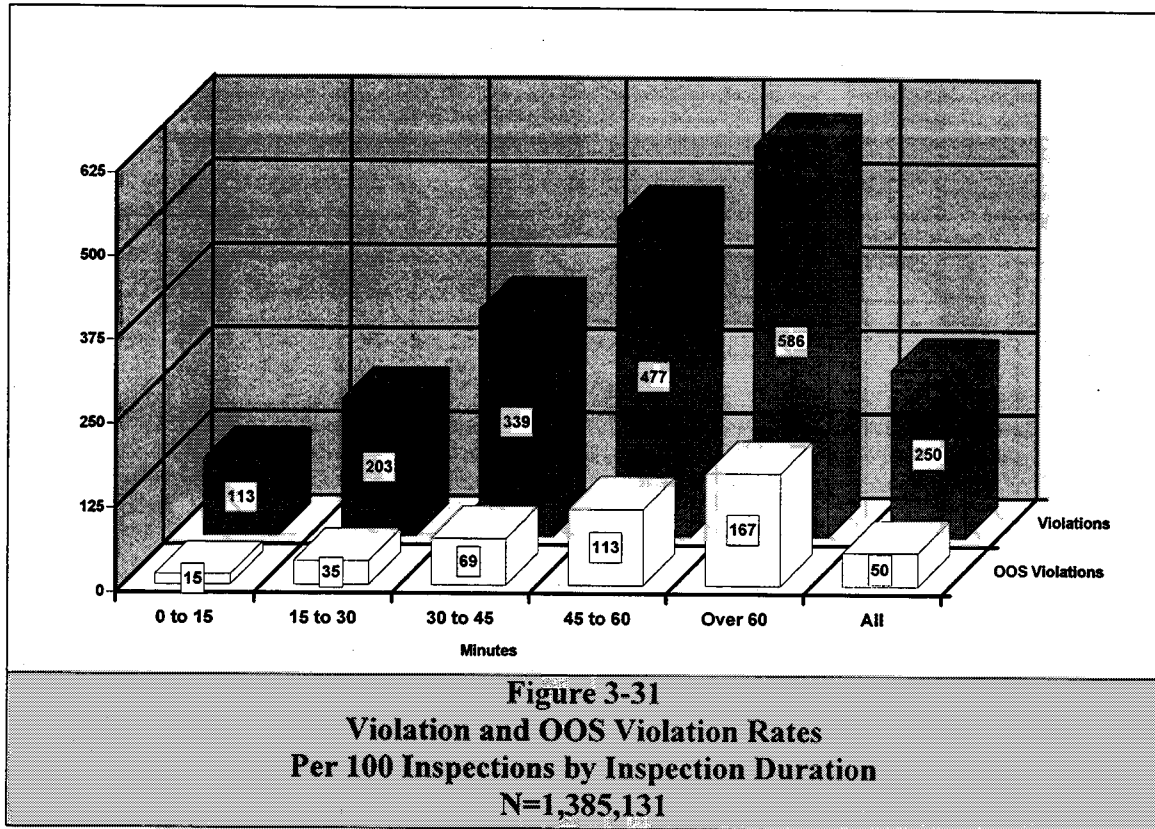


Figure 3-30
Percent of Inspections
15-30 Minutes and Over 60 Minutes Duration
By Vehicle Configuration



Full Inspections, in 1994, clearly constituted the optimal methodology, if the goal was to maximize the detection of violations. Not only was the raw count of violations per inspection-hour highest with Full Inspections, but the low violation-to-OOS violation ratio (4.5) shows that Full Inspections were more likely to result in the detection of the severe violations than Walk-Arounds and Driver-Only Inspections.

Of course, if the goal was to inspect a greater percentage of all the vehicles passing through inspection facilities—or to look for specific vehicle or driver defects—the other inspection methodologies might sometimes have been preferable.

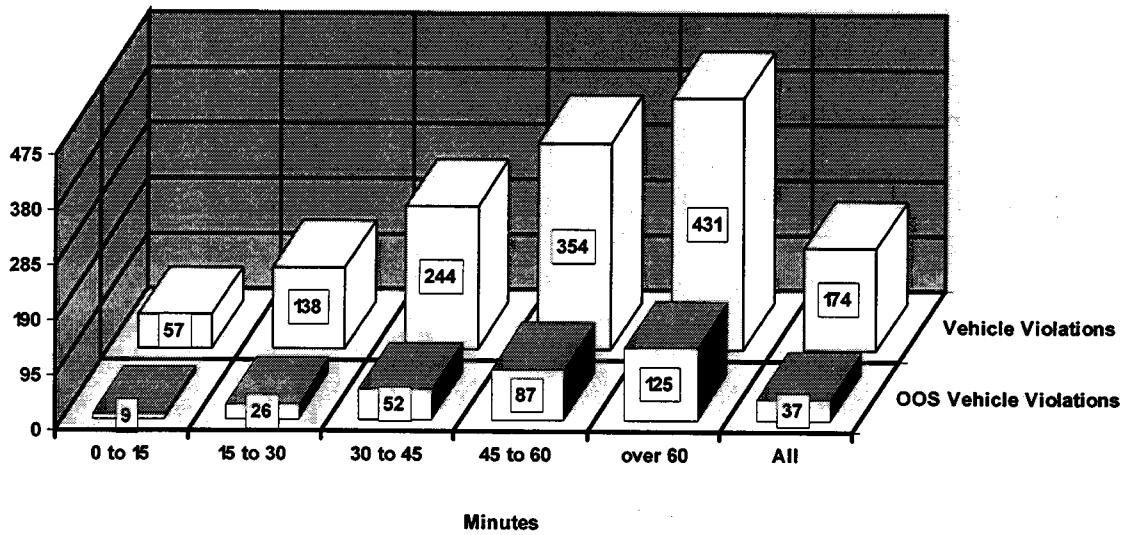


Figure 3-32
Vehicle Violation and OOS Violation Rates
Per 100 Inspections by Inspection Duration
N=1,385,131

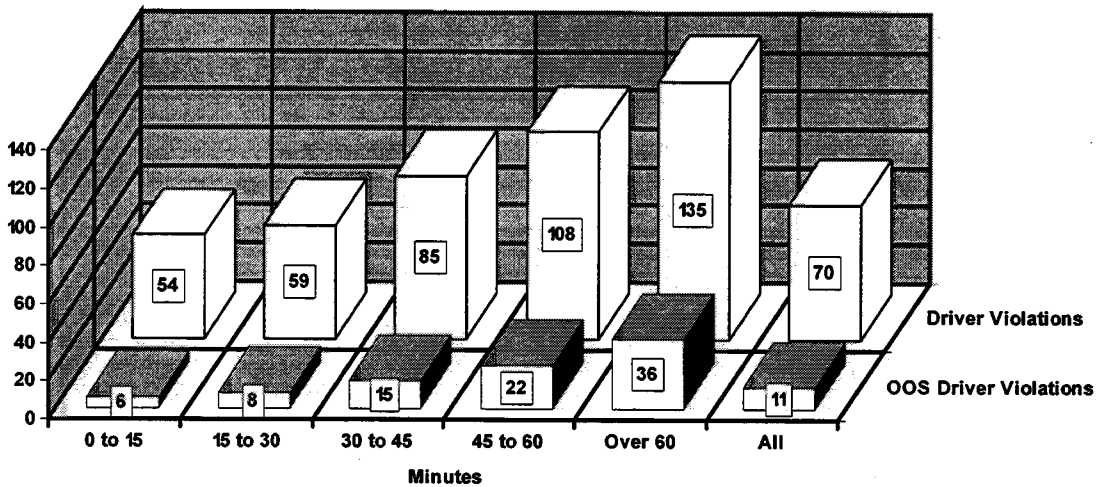


Figure 3-33
Driver Violation and OOS Violation Rates
Per 100 Inspections by Inspection Duration
N=1,385,131

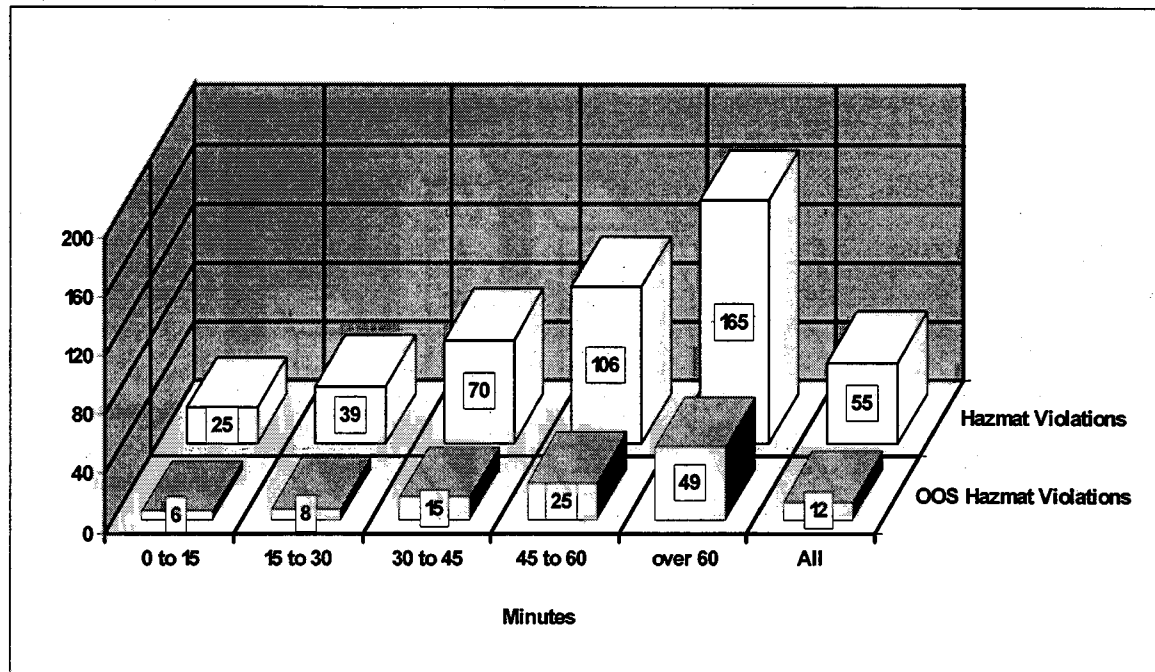


Figure 3-34
Hazardous Material Violation and OOS Violation Rates
Per 100 Hazardous Materials Inspections by Inspection Duration
N=134,603

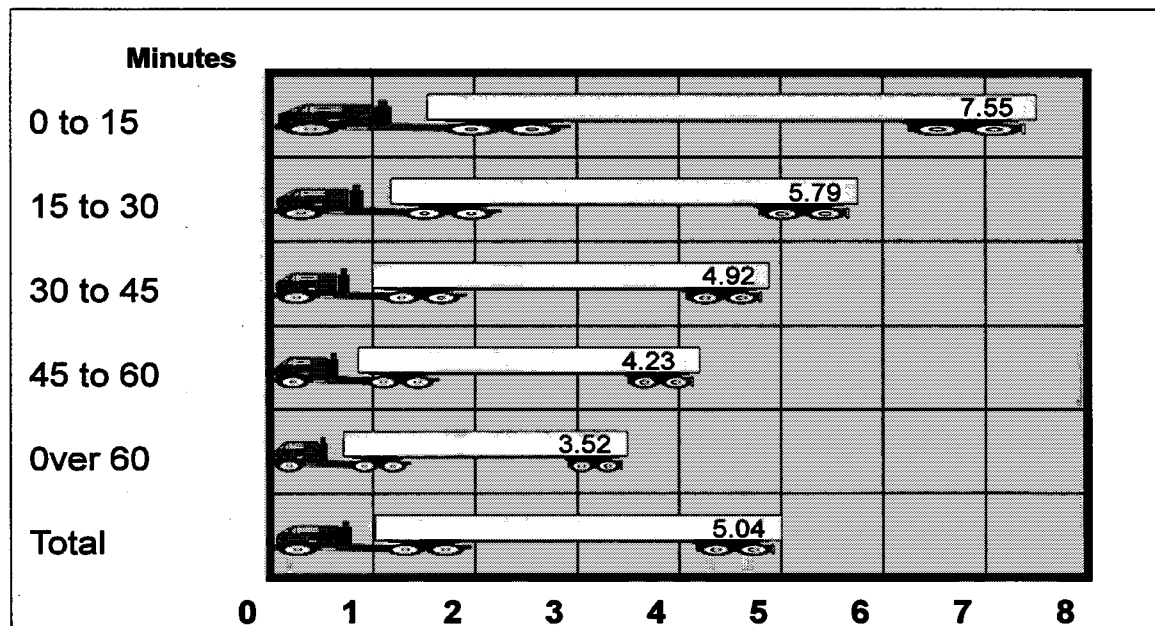


Figure 3-35
Ratios of Total Violations to Out-of-Service Violations
By Inspection Duration
N=1,385,131

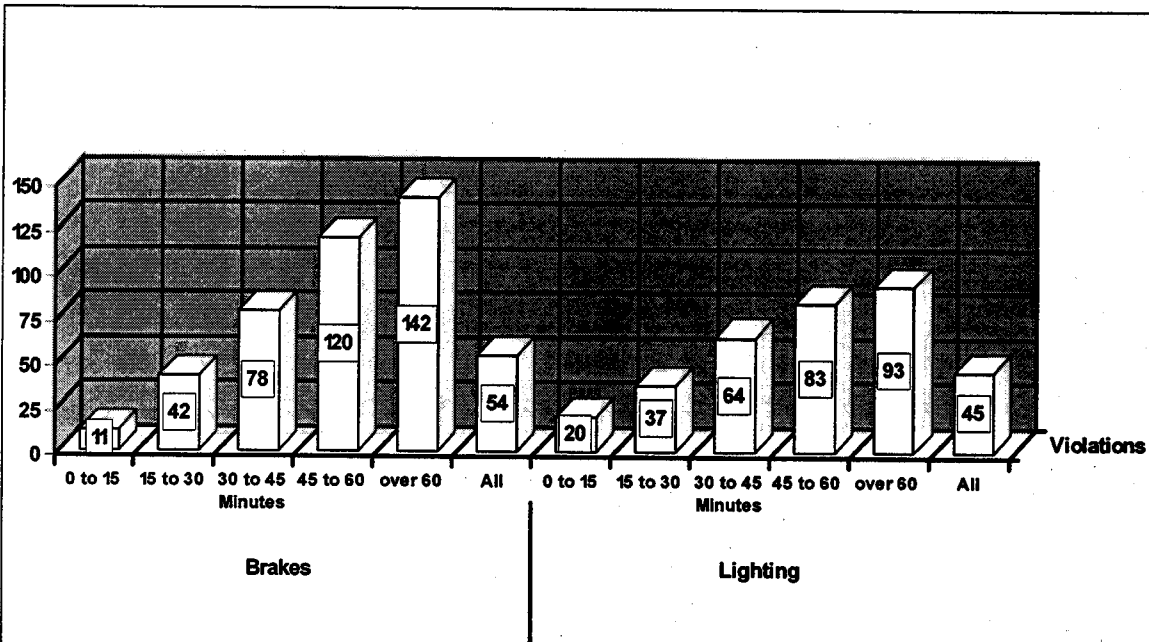


Figure 3-36
Brake/Lighting Defects by Inspection Duration
Violation Rates Per 100 Inspections

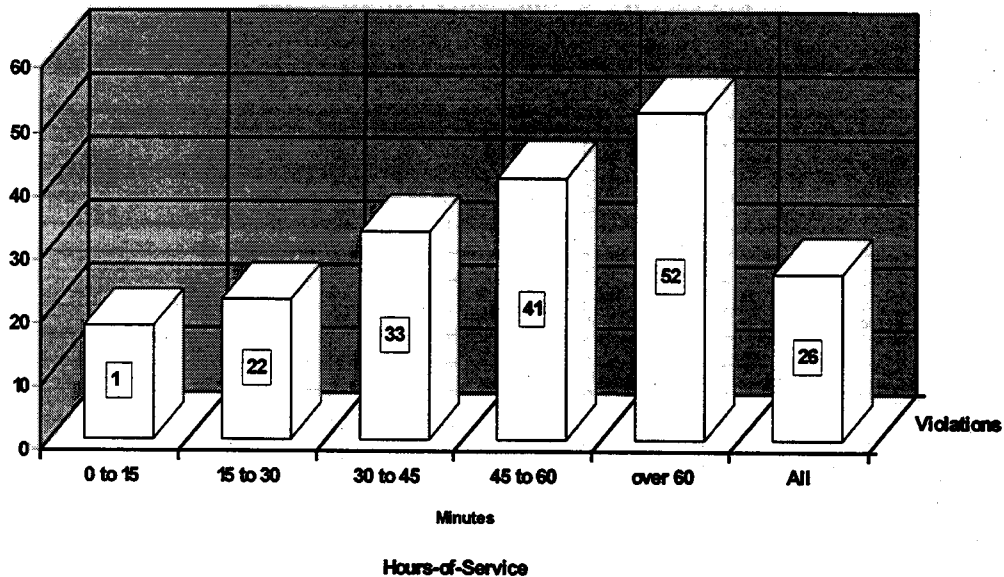


Figure 3-37
Hours-of-Service Defects by Inspection Duration
Violation Rates per 100 Inspections

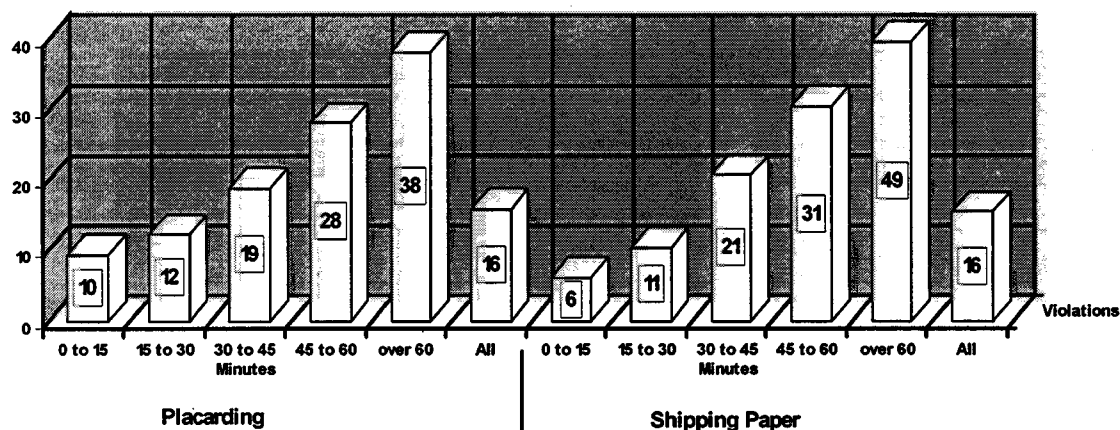


Figure 3-38
Placarding/Shipping Paper Defects by Inspection Duration
Violation Rates per 100 HazMat Inspections

Table 3-12
Violation Rates and Normalized Rates
By Inspection Level and Duration

	Full	Walk-Around	Driver-Only	Terminal	Special	All
Violations per Inspection	3.21	2.38	0.96	1.68	1.82	2.50
OOS Violations per Inspection	0.72	0.37	0.16	0.37	0.43	0.50
Ratio of Violations to OOS Violations	4.46	6.43	6.00	4.54	4.23	5.00
Mean Duration (Minutes)	34.54	29.76	22.78	33.61	42.73	30.86
Mean Number of Inspections per Hour	1.74	2.02	2.63	1.79	1.40	1.94
Violations per Hour	5.59	4.81	2.52	3.01	2.55	4.85
OOS Violations per Hour	1.25	0.75	0.42	0.66	0.60	0.97
Ratio of Violations to OOS Violation	4.47	6.44	5.99	4.55	4.22	4.99

APPENDIX

Glossary of Terms Common Vehicle Configurations

GLOSSARY OF TERMS

BUS: Any motor vehicle designed, constructed, and used for the commercial transportation of 15 or more passengers, including the driver.

CARRIER TYPE: "For-hire" or "private."

COMMERCIAL VEHICLE: A motor vehicle, usually a truck or bus, which transports freight or passengers.

COMMERCIAL VEHICLE SAFETY ALLIANCE (CVSA): An organization of States and Provinces in the United States, Canada, and Mexico dedicated to improving the uniformity of commercial motor vehicle safety enforcement.

DEFECT GROUP: The "group" to which a given violation is attributed. In this report, all violations identifiable during driver-vehicle inspections are assigned to one of three mutually-exclusive groups: *vehicles*, *drivers*, or *hazardous materials*.

DOUBLE: A commercial motor vehicle consisting of a truck-tractor and two detachable trailers.

DRIVER-ONLY INSPECTION: Examines only the driver-related aspects of the standard Full Inspection, including compliance with commercial drivers' licensing requirements, medical certifications and waivers, and the hours-of-service regulations. This inspection type is a *Level III* inspection.

DRIVER VIOLATION: A violation discovered during the inspection which pertains to the driver of the commercial vehicle.

DURATION: The amount of time required to complete a given inspection. It is calculated

using the "start" and "finish" times recorded by the inspector on the inspection document.

FACILITY TYPE: The type of facility—*fixed* or *mobile*—at which the inspection was conducted.

FEDERAL MOTOR CARRIER SAFETY REGULATIONS (FMCSR): Regulations governing the safe operation of commercial vehicles engaged in interstate commerce. The FMCSR are contained in the *Code of Federal Regulations*, Title 49, Subtitle B, Chapter III. States participating in MCSAP have adopted their own State-level versions of the FMCSR.

FIXED FACILITY: A State commercial vehicle "scale" facility or other permanent site used for the conduct of inspections.

FLEET SIZE: The total number of power units (truck-tractors and straight trucks) owned or operated by a given motor carrier.

FOR-HIRE CARRIER: A commercial motor carrier whose primary business activity is the transportation of property by motor vehicle for compensation.

FOR-HIRE CARRIER—AUTHORIZED: A for-hire carrier subject to economic regulation by the Interstate Commerce Commission.

FOR-HIRE CARRIER—EXEMPT: A for-hire carrier *not* subject to economic regulation by the Interstate Commerce Commission.

FULL INSPECTION: The most comprehensive and thorough of the inspection types, it involves extensive vehicle checks—including under-the-vehicle measurement of brake performance—and examination of hours-of-service logs. This inspection type is a *Level I* inspection; it is also sometimes referred to as the *North American Standard (NAS)*.

HAZARDOUS MATERIALS: Materials, substances, or wastes which, due to their compositional nature, may be toxic, harmful, or fatal if accidentally exposed to humans, animals, or the environment.

HAZARDOUS MATERIALS REGULATIONS (HMR): Federal regulations governing the commercial transportation of hazardous materials. The HMR are contained in the *Code of Federal Regulations*, Title 49, Subtitle B, Chapter I.

HAZARDOUS MATERIALS VIOLATION: A violation discovered during the inspection which pertains to the transportation of hazardous materials.

INSPECTION: The systematic examination of a commercial motor vehicle and its driver to determine their overall safety fitness.

INSPECTION LEVEL: Refers to the inspection methodology employed in the examination of a given vehicle and driver. Five inspection levels are referenced in this report: *Full, Walk-Around, Driver-Only, Terminal, and Special*.

INTERSTATE CARRIER: A carrier who sometimes or always operates in interstate or foreign commerce. For the purposes of this report, "interstate carrier" is defined also to include carriers of hazardous materials who operate in interstate, foreign, or intrastate commerce.

INTERSTATE MOTOR CARRIER INSPECTION DATABASE: A database on the OMC mainframe computer containing records of inspections of interstate carriers. State inspection records are uploaded to the mainframe using SAFETYNET.

INTRASTATE CARRIER: A carrier who operates solely in intrastate commerce and, for

the purposes of this report, never transports hazardous materials.

LOCATION: The U.S. State or Territory, Canadian Province, or Mexican State in which a specific inspection was conducted.

MOBILE INSPECTION FACILITY: A non-permanent inspection facility. Mobile facilities can be moved from one location to another, as conditions warrant. Sometimes called a "roadside" facility.

MOTOR CARRIER CENSUS DATABASE: A database on the OMC mainframe containing information identifying interstate commercial carriers. A unique USDOT Number is assigned to each carrier in the database and is used to link records in the Inspection Database to the appropriate carriers in the Census Database.

MOTOR CARRIER MANAGEMENT INFORMATION SYSTEM (MCMIS): The computerized system, operated by the OMC, containing comprehensive safety data on interstate commercial carriers. Two parts of MCMIS are the *Interstate Motor Carrier Inspection Database* and the *Motor Carrier Census Database*.

MOTOR CARRIER SAFETY ASSISTANCE PROGRAM (MCSAP): A Federal program providing funds to U.S. States and territories for activities in support of commercial motor vehicle safety. To receive MCSAP funds, States must adopt interstate and intrastate regulations which are compatible with the FMCSR and HMR. The OMC is the Federal agency responsible for administering MCSAP.

OFFICE OF MOTOR CARRIERS (OMC): The agency within the U.S. Federal Highway Administration responsible for commercial vehicle safety.

OOS VIOLATION RATE: The mean number of OOS violations per 100 inspections.

OUT-OF-SERVICE (OOS) VIOLATION: A violation of the FMCSR or HMR requiring that a commercial vehicle or driver be taken out of service or moved off the road until the circumstances which caused the violation have been resolved or corrected.

PRIVATE CARRIER: A commercial motor carrier for which private highway transportation activities are incidental to, and only in furtherance of, its primary business activity.

SAFETYNET: A State-based information system used to store and process commercial carrier safety information, including driver-vehicle inspection data. The use of SAFETYNET ensures that data electronically transferred to MCMIS are in a standard format and have successfully passed through a variety of edit checks.

SINGLE: A commercial motor vehicle consisting of a truck-tractor and a detachable trailer.

SPECIAL STUDY: Ad hoc examination of particular items, usually inspected in support of a particular study or verification/refutation of a specific trend. This inspection type is a *Level IV* inspection.

STRAIGHT TRUCK: A commercial motor vehicle in which the power unit and cargo box are non-detachable.

TERMINAL INSPECTION: Examination of vehicles at carriers' terminal facilities. Although the inspection methodology employed may vary, a Walk-Around technique is generally used. Terminal inspections normally focus only on the "vehicle" aspects of the inspection process. This inspection type is a *Level V* inspection.

TRIPLE: A commercial motor vehicle consist-

ing of a truck-tractor and three detachable trailers.

TRUCK-TRACTOR: A self-propelled motor vehicle designed and primarily used to draw other vehicles.

USDOT NUMBER: An identification number assigned to all interstate commercial carriers regulated by the OMC. The number is used to track the safety records associated with a given carrier.

VEHICLE CONFIGURATION: Arrangement of the individual units—truck-tractors, trailers, etc.—comprising a commercial vehicle.

VEHICLE MILES OF TRAVEL (VMT): The total miles accumulated by all the vehicles operated by a given carrier, or a collection of carriers possessing designated characteristics, over a specified period of time.

VEHICLE VIOLATION: A violation discovered during the inspection which pertains to the commercial vehicle itself.

VIOLATION: A violation of the FMCSR or HMR.

VIOLATION RATE: The mean number of violations per 100 inspections.

VIOLATION-TO-OOS VIOLATION RATIO: The ratio of total violations to total out-of-service violations.

WALK-AROUND INSPECTION: Follows most procedures of the Full Inspection, except those actions which can only be accomplished by climbing underneath the vehicle (e.g., to measure brake performance). This inspection type is a *Level II* inspection.

Common Vehicle Configurations

Tractor



Straight Truck



Tractor-Trailer/Single



Tractor-Trailer/Double



Tractor-Trailer/Triple



Bus



U.S. Department
of Transportation

**Federal Highway
Administration**

400 Seventh St., S.W.
Washington, D.C. 20590

Official Business
Penalty for Private Use \$300